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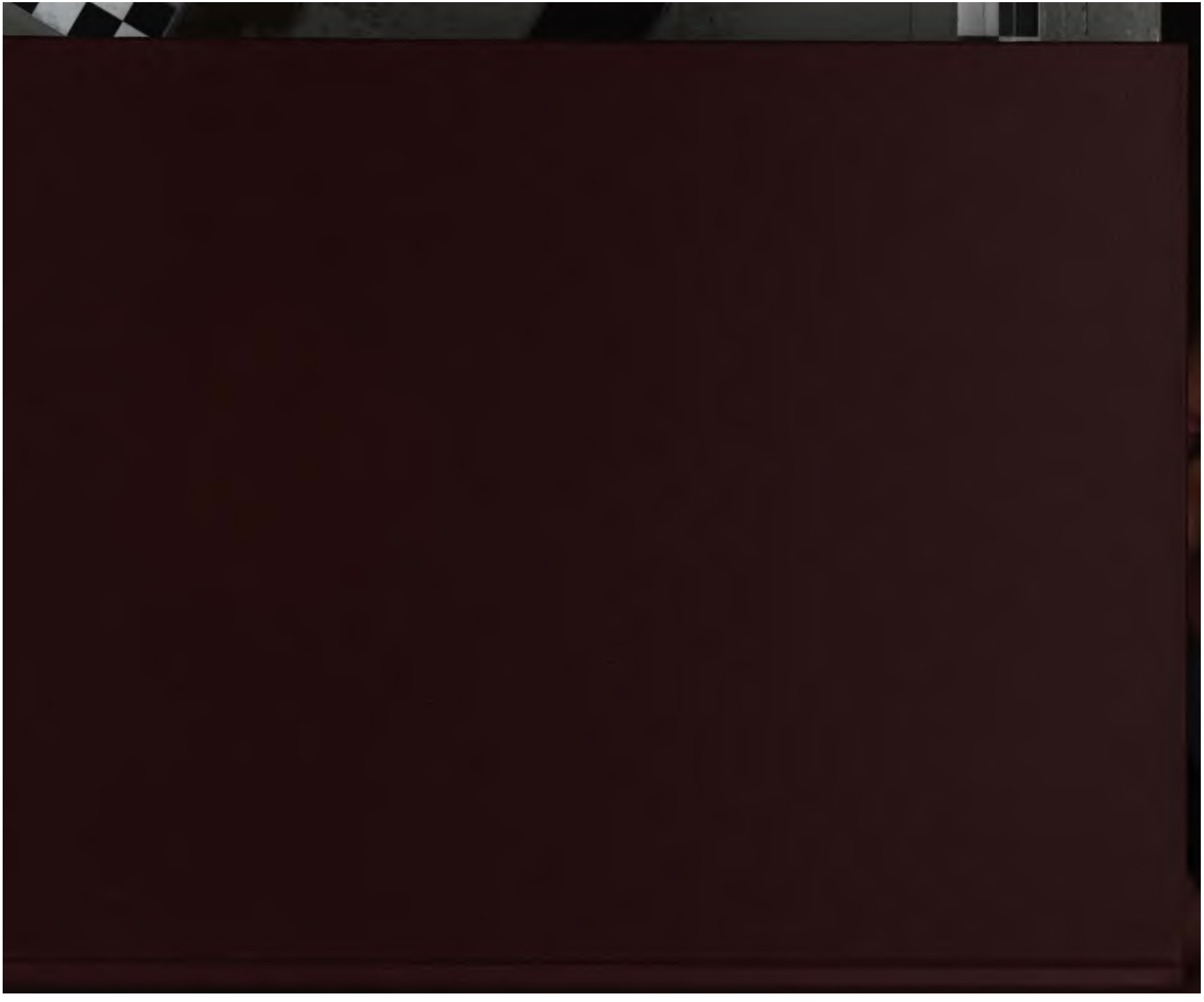

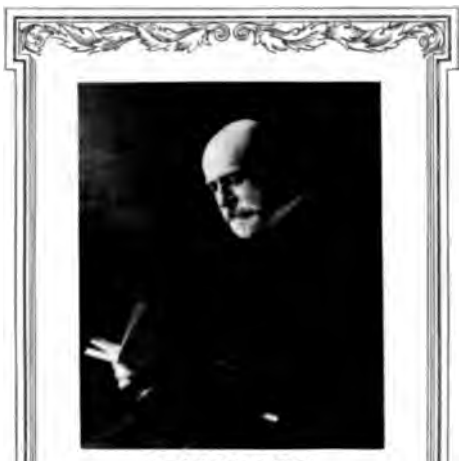
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J. C. Beaumont

AGRICULTURE

OF

NEW-YORK:

COMPRISING

AN ACCOUNT OF THE CLASSIFICATION, COMPOSITION AND DISTRIBUTION OF THE SOILS AND ROCKS,

AND THE NATURAL WATERS OF THE DIFFERENT GEOLOGICAL FORMATIONS;

TOGETHER WITH A CONDENSED VIEW OF THE

CLIMATE AND THE AGRICULTURAL PRODUCTIONS OF THE STATE.

BY EBENEZER EMMONS, M. D.

VOLUME II.

ALBANY:
PRINTED BY C. VAN BENTHUYSEN.
1849.

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TO HIS EXCELLENCY JOHN YOUNG,

Governor of the State of New-York.

SIR,

THE volume which I now place before your Excellency, is devoted mainly to the composition of the inorganic parts of vegetables. It is designed to aid the farmer in his immediate avocation. I hope, Sir, that the counsel which you have imparted in its preparation may not have been lost. It will be a source of satisfaction to me if I have succeeded in fulfilling your wishes, and have at the same time performed my duty acceptably to the farmers of New-York.

I am, Sir, your most obedient servant,

E. EMMONS.

ALBANY, November 1, 1848.

[redacted]

PREFACE.

THE preparation of this volume has occupied two years. To some, this may appear more than sufficient to have accomplished what is here recorded. Whatever view may be taken of it, I believe I am justified in saying that I know not how it would have been possible to have increased very materially the amount of labor in the time specified above. The law, whether right or wrong, required its completion on the first day of October last. The work would have been improved, and more valuable, had it been possible to have given more time to some subjects; inasmuch as the disproportion of labor would have been diminished, and each subject have received its due examination. But this, I repeat, has been impossible, notwithstanding the fact that I have employed an assistant for the whole period, and have continued the work about four months beyond the time specified in the act authorizing the continuance of the Survey.

Mr. J. H. SALISBURY, who commenced the study of analytic chemistry three years since in my laboratory, and whose services were noticed in my last volume, has continued them, and his work is distinguished by the initial of his name. He has also kept for me the observations on temperature, as recorded in the appendix, for this place. L. C. BALL, esquire, of Hoosic-falls, has also contributed observations and analyses for this volume. Mr. C. B. SALISBURY, of Scott, Cortland county, is deserving of the thanks of the community for his observations on the temperature of the soil of that place, which is supposed to be elevated about 1200 feet above tide at Albany.

It will be observed, that in some of the analyses of the ash of wood, the footing is too great. This arises from calculating an amount of carbonic acid sufficient to saturate the lime. There are cases where the carbonic

acid was not actually obtained; and this result, showing an excess in the amount of the elements over that employed in the analyses, is due to the caustic or subcaustic state of the ash. The error is in the carbonic acid, and not in the essential elements. Carbonic acid is sometimes referred to as if it were one of the original elements of the wood, while in reality it usually results from the conversion in combustion of an organic into carbonic acid. So in the case of sulphuric acid, it is not oil of vitriol in grain or straw; but when burned, the sulphur of the proteine compounds acquires oxygen, and hence it is often a secondary result.

The irregularity in the numbering of the plates has arisen from the fact, that when I began the volume, it was intended to embrace the descriptions of the fruits; but it was ascertained that the volume would be too large if the original intention was carried out, and hence it was deemed advisable to give the matter treating of the fruits in a separate volume. This part of the work is considerably advanced, and will be ready for publication in the course of the year.

ALBANY, February 1, 1849.

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REPORT

ON THE

AGRICULTURE OF THE STATE OF NEW-YORK.

PART II.

CHAPTER I.

PRELIMINARY OBSERVATIONS.

INORGANIC ELEMENTS OF VEGETABLES: THEIR NUMBER FEW; THEIR CHARACTER, ORIGIN, AND SOME OF THEIR COMBINATIONS. SILEX, ITS RELATIONS AND USES IN PLANTS. ALUMINA, LIME, MAGNESIA; PHOSPHORUS, SULPHUR; IRON, MANGANESE; POTASH, SODA AND AMMONIA; CHLORINE, CARBON, OXYGEN, NITROGEN AND HYDROGEN. CARBONIC ACID AND ORGANIC MATTER; THEIR UTILITY IN SOILS. VEGETABLE SUBSTANCES: STARCH, LIGNIN, GUM, DEXTRINE; EXTRACTIVE AND COLORING MATTERS. ANIMAL SUBSTANCES: PROTEIN; ALBUMEN, FIBRIN, CASEIN, GLUTEN, GELATIN; BLOOD; MILK. — RECAPITULATION.

In the preceding volume of the Agriculture of New-York, I attempted to give the results of many analyses of the soils peculiar to the State, the object of which was the determination of the amount of nutritive matter contained in them. This seemed to be required, as one of the first steps which should be taken to elucidate, in the order most natural, the principles which lie at the foundation of all improvements in husbandry. That the composition of soils requires a full and perfect determination, is now admitted. It is only by possessing this knowledge, that the farmer can cultivate his lands understandingly, or cease to work empirically or by rote. A knowledge of the composition of soils is not all that is requisite to good and profitable farming: there is still remaining an entire field of facts, to which the husbandman should by no means remain a stranger. These facts relate

to the food of plants. There is first that general store-house of inorganic matter, from which all kinds of plants select the peculiar elements which they respectively require for the nutrition of their bodies. We may note, in the first place in this branch of inquiry, that different families of vegetables require different sorts of food. That which nourishes the wheat plant, is not so essential to flax and hemp, or to the potato. It is true, that in a majority of cases, the same substances may be found in different families of plants; but there still remains the fact, that the proportions required of a given element differ greatly. It is then quite important to know what is especially wanted in a given vegetable, as wheat, rye or indian corn. In addition to the study here briefly alluded to, we, unconsciously, as it were, extend our inquiries to the conditions on which life and organization depend. The distribution or destination of nutritive substances is governed by law. We are not left for a moment to suppose that nutriment is borne to each organ in the same degree, and in the same amount. This, as will be seen by reference to analyses to be detailed hereafter, is beautifully illustrated in the cereals: we find only traces of the carbonates of lime and magnesia in their seeds or kernels, while the ash of the stems and leaves furnishes both in considerable quantities. So carbonate of lime is in great abundance in the bark of most trees, while it is less in quantity in the wood, and still less in leaves, flowers and seeds. Such results could never have been secured, except under conditions that have been imposed by laws which regulate the life and growth of all living beings.

In the execution of the plan of this work, I shall proceed to detail the researches I have made on the composition of the inorganic parts of plants which have grown upon the soils of this State, the general characters of which have been already given in a former volume. I desire to connect together, as far as possible, the soil and its products; or, in other words, to trace the relations which exist between the soil, and the living beings which vegetate upon it. That this desire might be carried out as far as practicable under existing circumstances, repeated additional analyses have been made of the same soil when its immediate products could be obtained. I deemed it highly necessary to investigate minutely the products of the soil of each of the several districts, for the purpose of ascertaining the adaptations of each. The work, however, is too great to be executed in the time allotted to the survey, but it is hoped that enough has been done to aid the farmer to a certain extent. This will not appear improbable, when it is known that the agricultural districts possess points of great similarity, and that the most essential properties of soils are common to each district respectively. So great indeed is the uniformity, that we may calculate the quantity of certain elements which exist in their respective areas, and hence determine in each instance how long it will answer to cultivate exhausting crops.

It is scarcely necessary to say, that we arrive at a knowledge of the most essential part of the food of plants by an analysis of the ash. Although the carbonaceous matter which is burned off is also important, still, so far as inquiries of the capabilities of the soil are concerned, the carbonaceous are of less importance than the inorganic and fixed parts; for so essential are these fixed matters, that the very existence of vegetables depends upon them. They constitute the frame work or skeleton, and can not be dispensed with; and hence

where lands have been cropped for a long time, these matters become so far diminished in quantity that a profitable cultivation ceases. The object, then, of the analysis of plants is to ascertain what elements enter into their composition, and how much is requisite to give that perfection which is most profitable to the cultivator. And it is upon this kind of knowledge that the most profitable rotation of crops is based; for, as has been stated already, plants differ among themselves as it regards the special elements which they require, and also in the relative amount of those elements; and hence it is possible to devise an expenditure of a store of food in the soil, which shall ultimately end in a great saving of labor, as well as an increase of direct profits.

To carry out the objects here alluded to, numerous analyses of plants have been undertaken, the results of which it is proposed to give in this volume. I should perhaps proceed at once to this part of the work; but it seems best, in the first place, to state somewhat in detail the characters of those elements which constitute so much that is essential to the plant. I shall first recount all that seems to be essentially necessary for the farmer to know concerning the functions or offices of the elements of plants; and I do not, therefore, here take it for granted that my readers are already familiar with these subjects; for experience in these matters not unfrequently proves that our readers or hearers know less than we expected, and, in fact, are ignorant of many things of which we by no means had supposed it possible. I would wish certainly to pursue a plan in which plainness and simplicity shall appear prominent, and which shall be as free as possible from subjects that have not been explained to ordinary readers.

We may then regard it as an essential part of the attainments of a farmer, to possess a knowledge of those bodies which enter into the composition of the plants which he cultivates, and even of all plants, inasmuch as they minister directly or indirectly to his interests. Regarded in a general point of view, it is not difficult to see in what way they affect his interests; even in vegetables, though they do not contribute to his nourishment, or that of his cattle, still their office must be taken into account. It is better that a field be covered with vegetation, than to lie naked. In the former case, the growing plants bring up from beneath, and to the surface, elementary substances which, if properly managed, can not fail of contributing to the growth of a succeeding crop. That which it is necessary to know upon this subject, is what particular nutritive elements are brought to the surface, which, by decay, will remain for the improvement of the crop we propose to cultivate. What elements, for example, does the growing buckwheat bring up to the surface, which, when ploughed in, shall become food for wheat or maize? This question can be answered only by an analysis of the ash of the plant itself. This being correctly performed, we shall then know not only what elements are mixed with the surface soil, but we possess facts by which we can determine the amount we have in the crop of buckwheat also. So too we may know how rapidly we exhaust the store of food by the continual raising of a given crop. By such researches, we connect the character of the elements with that of the vegetable of which they form a constituent portion, and we connect the elements of the vegetable with vegetable and animal life.

PRELIMINARY OBSERVATIONS.

It is a remarkable fact that those elements which are of the highest importance in the imal and vegetable economy, form but an inconsiderable part of the soil. The tissues the animal frame are composed of the salts of phosphorus, which, in order to be detected the earth, require the utmost nicety in chemical manipulation; while the compounds of ne, magnesia and silica, are far more abundant.

It can not be said that the elements forming the essential part of the soil are numerous; d hence it may be inferred, that the elements which constitute the frame work of vege- bles and animals are also comparatively few in number. Of those which exist in the il, the following enumeration comprehends the entire list, so far at least as can be re- rded as essential to organization: Silex, alumina, lime, magnesia, iron, manganese, tash, soda, phosphoric acid, sulphur, chlorine, carbonic acid, ammonia, the elements of ater and air, and nitrogen, oxygen, hydrogen and carbon in an oxidized state. They may regarded as forming very naturally two classes of bodies: those which form the frame ork of the tissues; and those which fill up, as it were, the interstices. In the former, or in e frame work of the tissues, we find silex, lime, magnesia in combination with phosphoric d carbonic acids; in the latter, carbon, hydrogen and nitrogen in various combinations e found. It is an important fact, established by the analyses which I am about to give, at each tissue has its own distinct organization; that they respectively possess their ele- entary bodies in proportions peculiar to themselves. For example, the constituents of e leaf of a currant differ from those of the stem, bark, flower or wood; the kernel of heat, from its envelopes, the husk or stalk. But what is practically still more interesting d important, these component parts may be modified by culture and by soil. The law, owever, that certain elements or bodies are determined towards specific parts, is un- fected: that the phosphates of magnesia and lime are determined to the essentially itritive parts of the plants, is a universal fact; the modifications produced by a rich soil d high culture are mainly seen in their accumulated quantity, and it is not very unlike at process called the *laying on of fat* in certain parts by some breeds of domestic ani- als. We shall have occasion to treat of this interesting subject more at large, being w more immediately concerned with the elementary bodies alluded to in the preceding ragraphs.

SILEX, SILICA, SILICIC ACID.

These three names are synonymous. The substance is familiar to all, in the forms and nditions of white sand, flint, and crystals of quartz. In those forms it is commonly re- rded as pure silex, and is so called; but when it is combined with other bodies, or is in soluble state, it is called *silicic acid*, because it performs the functions of that class of odies which are known as acids, and not because it has the taste which acids are com- only supposed to possess; for it is really tasteless, and produces no change upon litmus. Silex is scarcely soluble in water, or in the ordinary acids; but it is perfectly soluble in oric acid, and in potash when aided by heat. The alkalies give it a solubility which it

retains as long as it is moist; but when dried, and especially when ignited, it becomes insoluble again: hence it is often spoken of as soluble and insoluble silica. In silicated plants, as the cereals, it retains its solubility if they undergo in the ground a slow decay, and we may dissolve it in our analysis along with the phosphates. If, however, these vegetables are burned, their silica becomes insoluble mostly, although it is minutely divided.

Silex is white when pure, and harsh and gritty to the feel, but fuses easily with soda into a transparent bead. It is also dissolved in the hydrated vapor of fluoric acid, for which substance it is regarded a test.

In this connection, it is proper to speak of silica as a constituent of soils, and of its uses and functions, as a part of the vegetable tissues. It has its mechanical importance in both relations; and so abundant is it both in its separate and combined states, that it must be regarded as one of the most essential bodies in nature.

1. *Silica as an element of soil.* In quantity it forms more than 60 per centum, and sometimes its percentage is as high as 95. Taking its average range as about 78·79 per centum, we find it entering more largely into the composition of soil than any other element. In this fact, we discern that its function as an earth in the midst of earths is important: it must impart its own characters to the compound. In itself, silica is a dry, white, harsh-feeling powder, destitute nearly of affinity for water, and admitting the free passage of fluids through it without affecting them in the least. It is then an element which is designed to give porosity to soil, in order that water and air may be admitted into its texture. If soils contain too little of it, they are close and impervious; if too much, water percolates too rapidly through them. Soil is not tempered with an excessive dose of silex when it amounts to 85 per centum: above that proportion, the soil becomes rapidly porous and loose, and can not be cultivated without annual additions of manure.

2. *Silica as an element of organized bodies.* Silica or sand is not taken up by the roots of plants as such, in consequence of its insolubility; but it requires to be in combination with other substances, in order to give it this property. What these substances are, has been stated already, namely, potash and the alkalies. Silica then enters into the composition of vegetables, though not in equal proportions in different parts of the same plant. Its presence can not be regarded as accidental; for instance, in 100 parts of the ash of the straw of the creeping wheat, it amounts to 69·66; in the grain, to only 2·56. In the ash of forest trees, it is never half as much. In the stalks of all the cereals, however, it exists in large percentages. It gives strength to the straw, and may be regarded as the element which supports and protects it. In order that the grains and grasses may take up silica, it is necessary that the fluids of the soil should be able to dissolve it.

Although an immense quantity of silica exists in a free and insoluble condition, and it would seem necessarily so, yet, in the constitution of the globe, provision is made for its solubility. This provision may be seen in its numerous combinations with the alkalies and alkaline earths. With these it has been united by fusion; and, as we have already stated, this is one of the modes resorted to for giving it solubility. In the natural progress of the decomposition of the silicated earths and alkalies in a moist soil, and by the at-

mospheric influence, a large portion of this combined silica, when set free, retains its solubility. New or virgin soils are particularly rich in soluble silica and the elements of carbonic acid : hence the cereals find in them their best location, and yield abundant returns. When tillage has exhausted them of silica in its soluble state, the straw is weak, and the harvest fails, unless artificially supplied. All plants take up this earth, but it is in the cereals and grasses that it abounds. In some the quantity is so small, that it may be regarded as accidentally present.

But I may yet remark, that many bodies which contain potash are easily decomposed by the ordinary atmospheric agents to which they are exposed ; thus, granite, which is in part felspar, is a remarkable instance where decomposition furnishes soluble silica. The potash with which it is combined in the hard rock, yields to the action of carbonic acid and water. The same may be said of hornblende and basalt, or of the pyrogenic rocks as a class. The clay slate, or the slates of the Taconic system, as well as those of the higher classes in the New-York system, furnish both silica and potash by decomposition : hence a glass may be formed which is very soluble, and may be used as a manure.

A remarkably striking instance of decomposing action is that of carbonic acid upon the hardest of substances, such as that which is constantly exhibited upon the tumblers used for dipping the carbonated waters of Saratoga. These, in the course of a few days' use, lose their transparency, and look as if they really required washing before they would be fit for dipping. It is the alkaline matter of the glass which is attacked in the first instance. The silica, however, is all of it soluble, and is slowly washed away. This action will be increased in proportion to the amount of alkali used in the composition of the glass.

The formation of silica, as described in the foregoing paragraphs, is an illustration of the mode by which soils have been produced. Only a small portion, however, of the debris of rocks is in a condition to become the food of plants at any given period. The process is slow, but, as must be seen, it is the one best adapted to the wants of vegetation.

The most important and interesting fact in regard to silica, is the two distinct chemical characters which it possesses ; that of being soluble in water and weak acids at one time, and almost insoluble at another. In one state, it is the sustaining and protecting agent in the tissues of a vegetable ; in the other, it sustains the root and whole plant, and is the medium through which nutritive matters are introduced, that is to say, it forms the soil in which plants are destined to grow, and at the same time affords them an outward mechanical support. It is in the most delicate and useful vegetables, the grasses and grains, that silica forms a large proportion of the tissues, or in those plants where it seems lime would be insufficient to perform the same office.

ALUMINE, ALUMINA, SILICATE OF ALUMINA, OR CLAY.

It will not be far from the truth, to assert that alumine or clay possesses characters opposed to those of silica. Whether true or not in its full extent, it is certainly less soluble

than silica, and very rarely if ever enters into the constitution of vegetables, so as to form an essential part of their tissues. If its functions as a part of the soil are also taken into account, it is found to differ essentially from the former. Silica, as already observed, preserves the soil in an open or free state : alumine, on the contrary, makes it consistent, compact and impervious. The functions of this body are confined to the soil. It is necessary to observe that it is not the pure alumina of chemists which forms so large a portion of what is termed *clay soils*, but a silicate of alumina. Alumina, however, exists in two conditions even here : one of which is easily soluble, and may be called free alumina; the other is comparatively insoluble and fixed, and before it can be fully dissolved even in the strong acids, requires fusion with the alkalies or alkaline earths.

The facts most important to be known in the history of alumina, are the following : First, its insolubility in water; secondly, its neutral action on plants; thirdly, the impervious condition it imparts to soil; fourthly, its uniform state of fineness; and, fifthly, its high affinity for water. It never forms a gravel, nor is ever found in coarse particles like the gravel of silica. This great degree of fineness is seen when it is diffused in water : weeks are sometimes required for the water in which it is diffused to become clear.

It is unnecessary to dwell longer upon the properties of alumina : the most important facts, though briefly alluded to, are sufficient to answer the objects in view.

The two foregoing bodies, silica and alumina, form the basis of all soils, and to their presence the soils owe their main and permanent characters. The presence of other elements produce but trifling modifications. Organic matter exerts a greater influence than any of the earths. The body or basis being thus constituted, the remaining elements, along with soluble silica, may be regarded as food, or as matter out of which the frame work of the various tissues is formed. Although this is without doubt true, yet it is proper, before leaving the subject, to say of soil composed entirely of those bodies termed nutritive, that if composed of either singly, it would form but a barren waste. A pure limestone soil, or one mixed with silica and subcarbonate of lime, would be infertile. It is not a matter of indifference what constitutes the basis or substratum of soils. This must be a peculiar medium having certain relations to water and other bodies, which, if not secured by and in their physical or mechanical properties, would render nugatory the labors of the farmer.

Most of the earths possess low absorbent properties. Alumina, however, when pure, or as a silicate, ranks high in this important particular. The rapid absorption of ammonia by clay, renders it a receptacle or reservoir of this element. Odors, too, may be expelled from clothes and other articles, by burying the articles in aluminous soil.

LIME.

Caustic lime, or the subcaustic hydrate of lime, is never an element of soil. Its affinity for carbonic acid permits it to exist only as a carbonate, or some neutral salt of lime.

Carbonate of lime, if obtained from pulverized limestone, would have nearly the same mechanical effect in soil as sand. It has but little affinity for water; and hence so far as it exerts any mechanical agency, it operates like sand. In the soils of New-York, and more especially in those of the New-England States, the quantity of carbonate of lime is so small, that it has no perceptible mechanical influence. But there is another form of carbonate of lime, which exerts a decided influence: this is marl, a carbonate of lime, which is in a state of fine subdivision, and is combined with 4 or 5 to 10 per centum of organic matter. This substance, which is esteemed highly as a fertilizer, is a powerful retainer of water: it even ranks higher than alumina. It truly deserves the reputation it has acquired as a fertilizer, though we doubt whether its real action in the soil has been understood.

Carbonate of lime, then, in the form we should obtain it by grinding rocks of limestone, would operate only mechanically like fine sand, by giving more porosity to the soil. In the form of marl, however, it gives tenacity to soil, by increasing its retentiveness.

Carbonate of lime, as a salt of the earth, owes its importance to the relations it sustains with organized bodies, as is shown by their analyses. It is almost always an element, and a most essential one, of the animal tissues. Thus in the lower orders of the animal kingdom, lime is necessary to form the shell, covering or habitation of the species; in the higher, the bones are composed of salts of lime, all of which are derived from the soil. So in the vegetable kingdom, salts of lime are abundant in the ashes of all kinds of woods, and especially so in that of bark. We may therefore regard this element as one of the most important, and one which must be present in all good soils.

Carbonate of lime is insoluble in pure water, but the farmer is under no necessity to provide the means for its solution. Rain water carries down to the earth carbonic acid, the presence of which enables water to dissolve it. So probably the development of carbonic acid in the soil itself may aid in giving solubility to carbonate of lime. I need not, however, dwell upon this subject, as, under carbonic acid and the organic matters of the soil, I shall have occasion to call the attention of the reader again to it.

The salts of lime, found in soils, are the phosphate, crenate, apocrenate, carbonate, and perhaps the humate and silicate. In weak acids, lime is quite soluble, but they form salts with different degrees of solubility in water. These salts are never in excess in any of the New-York soils: indeed they are really deficient, and, in good husbandry, have to be added in forms which are considered as a manure. In fact, one of the great efforts of the farmer is to supply lime in sufficient quantity to meet the wants of his crops.

Few subjects have enlisted the attention of agriculturists, so much as the use and effect of lime in and upon soils. The facts very generally go to prove its great value: its action, however, has not been so generally understood. A subject which involves many intricate questions can scarcely be expected to obtain for itself an uniform opinion, or a theory which all will readily adopt. Analysis proves the constant presence of lime in vegetables: hence there is no doubt that it should be present in all soils, to supply the wants of vegetation. But its use and functions do not terminate in supplying a material for nutriment: there are certain reactions of lime upon other elements in the soil, which equal in utility the one

just referred to. This reaction is upon the silicates of potash, and other alkalies. It has been shown by Prof. Fuchs of Munich, that the silicates of alumina and the alkalies are decomposed by mixture with milk of lime in a subcaustic state. The same action takes place when lime is mixed with the soil. There is, therefore, a liberation of silica and of potash, or the alkali with which the silica is combined. Besides this chemical reaction, the texture of clay soils is loosened, and the whole mass becomes porous and friable.

The functions of lime, then, it will be seen, consist, first, in supplying an element necessary to the plant; secondly, in liberating the alkalies in combination with silica; thirdly, in rendering the freed silica soluble; and fourthly, in giving porosity to argillaceous soils. Too much importance, therefore, can scarcely be given to lime as an agricultural agent. There are probably other actions and uses of a minor importance, which may be passed over without particular notice. Some of the uses attributed to lime seem rather problematical, or not well sustained by facts.

I have already intimated that all plants require lime. I do not know that this intimation requires modification or reserve. It is important, however, to state that the different parts and organs of plants require it in different proportions. The wants of a tree for lime can not be determined by an analysis of its wood or leaves, nor by that of its bark. In the outer coverings it is always greater than in the internal parts. Its presence is therefore functional and necessary.

In the foregoing remarks, I have had in view one variety of lime only, the subcaustic or subcarbonate in a hydrous condition. It is in this condition only that it is usually employed. I except here of course the phosphate of lime, as contained in bones, which exerts more of a physical effect upon the clay soils than the hydrous subcarbonate does.

Many farmers have used lime without benefit. In view of this fact, it may be stated that at the time the lime was used, it was not required, there being already sufficient in the soil for the purposes of vegetation, or for the use of the crop to be raised. Whenever there is a deficiency of the silicated alkalies and of organic matter, the effects of lime are not so apparent.

MAGNESIA.

The uses of magnesia, either as an element of soil or as a constituent of plants, are not so well known as the use of the salts of lime. It can exert but little influence mechanically on the soil, its proportion being very much smaller than that of lime; and though magnesian rocks are not unfrequent, still it never occurs in quantities sufficient to produce any perceptible effect in the texture of the soil. Magnesia, however, appears to be an essential constituent of the grains, as indian corn, wheat, etc., in which it even exceeds lime in quantity; thus, in the ash of rye it amounts to 12 per centum, while the lime is only 2·61. The carbonate requires 2000 parts of water for its solution, and is more insoluble than carbonate of lime. All the rocks furnish magnesia by their decomposition.

The most common form in which magnesia enters into the composition of plants, is that

of a phosphate. Whether the phosphate is formed in the soil, or in the plant, is a point difficult to determine. It is an element of food, and not of mechanical support. It is required as a constituent part of the grain; and the grain itself, in consequence of its composition, becomes an important nourishment for animals. It is necessary, however, to say that magnesia enters into the composition of the straw of the cereals, but in small proportion to the quantity in the grain. So it is found in the ash of fruit and forest trees, but the bark is almost destitute of it. In animals, it enters into the composition of the harder parts, as the internal and external skeletons, but in less proportion than lime. It forms salts with the same acids as lime. We have no facts which go to show that lime may replace the salts of magnesia, or the contrary.

The state in which magnesia is required by the cereals, is that of a phosphate. No grains contain the carbonate or other salts of magnesia, except in combination with phosphoric acid. I have so arranged the analyses of the cereals, that this fact may assume its proper importance. It will be seen, on consulting these analyses, that both magnesia and lime exist in the straw and chaff, while in the kernels they appear only in traces as carbonates.

PHOSPHORUS, PHOSPHORIC ACID, PHOSPHATE OF LIME, &c.

Phosphorus, which is one of the most remarkable of the simple substances or elements, exists in all organized bodies. It is never found simple in nature, and never enters as such into organized bodies. We have therefore nothing to say of it as such; but on its compound forms, or combinations with oxygen, lime and magnesia, and some other bodies, it is necessary to dwell for a moment. In plants, it is found combined in the four principal alkalies and alkaline earths, viz. lime, magnesia, potash and soda. It is also in combination with iron.

If the general presence of a substance is an evidence of its importance, the phosphoric compounds rank high in this respect. It is, however, in the fact that grains are its main receptacles, that its real importance is indicated. In respect to the quantity present in any particular part or organ, its distribution follows the same law as that which governs the distribution of other bodies; thus it is present in the wood, bark, leaves and fruit, but not in equal quantities. In the bark of trees, straw and chaff of grain, it is comparatively trifling in amount. In the leaves of many plants it is abundant. In all edible parts, however, it forms the largest proportion of the whole inorganic matter. These facts indicate very clearly the utility of its presence in soils; and not only this, but its amount; for as it is comparatively only in small quantities that it is always found, it is probable that it is one of the first which becomes exhausted by culture. In most soils, the phosphates are only appreciable, or just susceptible of being weighed in one hundred grains. A total absence of phosphates in a soil will render it barren and unproductive. It is not improbable that phosphate of lime may replace and become a substitute for that of magnesia, when the latter is very deficient in quantity.

On the general distribution of the phosphates, it is quite interesting to know that the phosphate of lime is distributed to the outer envelopes of a plant, the bark, cuticle, rind of fruits, etc.; while the phosphates of magnesia and iron pass to the interior, or to the seed, kernel or grain. These seem therefore especially designed for the animal tissues. Membrane and bone, blood and muscle, must contain a definite quantity of the phosphates in a healthy state; and when they are deficient in quantity, the bones are soft and flexible, and refuse to support the weight of the body.

Much has been said of the importance of supplying nitrogenous matters to soils. The phosphates can never be derived from the atmosphere, or from rain water, nor are they furnished by any of the ordinary processes of nature: hence, if they become exhausted, direct application must be made of some substance which contains them. They must be supplied by labor, and by somewhat expensive materials. Nitrogenous matters, however, are constantly being added to soils, by unceasing operations or agencies independent of man. The rain brings down ammonia to the earth, so that nitrogen can never be totally absent from any soil, though it may be deficient in quantity, or insufficient to supply the wants of artificial crops; but the phosphates can not be obtained when the soil has been exhausted of them, except by waiting the slow decomposition of rocks, or by a direct application of some material which contains them. It is towards this one thing, the supply of a sufficient quantity of substances abounding in the phosphates, that the farmer should direct all his measures. Other substances, though they may be important, yet are frequently so abundant that there is really no difficulty in obtaining them. This is the case with sulphuric acid, abundance of which exists in gypsum, and other cheap salts of the alkalies and alkaline earths.

Not intending, however, to diminish the weight of opinion in regard to the importance of adding nitrogenous matters to soils, it is notwithstanding proper that correct views should be entertained upon this subject; and I think that the statement of LIEBIG, in his work entitled "Chemistry in its applications to agriculture and physiology," puts the question in its proper light. He states, p. 75, that "the most decisive proof of the use of strong manure [strong in nitrogen] was obtained in Bingen (a town on the Rhine), where the produce and development of vines were highly increased by manuring them with such nitrogenous manure as the shavings of horn, etc.; but after some years, the formation of wood and leaves decreased, to the great loss of the proprietor, to such a degree that he has long had cause to regret his departure from the usual methods, ascertained by long experience to be the best. By the manure employed by him, the vines had been too much hastened in their growth: in two or three years they had exhausted the potash in the formation of fruit, leaves and wood, so that none remained for future crops, his manure not having contained any potash. There are vineyards," he remarks, "upon the Rhine, the plants of which are above one hundred years old, and all of them have been manured with cowdung, a manure rich in alkaline ingredients, but poor in nitrogen." The same system of manuring would end in the same disaster in all cultivated crops.

SULPHUR, SULPHURIC ACID.

It is now well known that sulphur and its combinations play an important part in the economy of life : hence it is another product to which the farmer must direct his attention.

No better criterion exists relative to the importance of a product, than that it should be found constantly in the blood and animal tissues. In the case of sulphur, it is always present in albumen and fibrin; and these are the proximate elements which supply the waste of the body, and by which its growth is promoted and secured. Sulphur, as it exists in albumen, fibrin or casein, is not in an oxidized state, as is proved by the spontaneous decomposition of these substances. When undergoing this change, it is sulphuretted hydrogen which is emitted.

Sulphur exists in many of the useful vegetables, as peas and beans, and indeed in all leguminous vegetables, both in their juices and mature seeds. In another family of plants, also, sulphur is an essential ingredient, namely, the *Cruciferæ*, as horse-radish, mustard and scurvy-grass.

Sulphur, as in the case of phosphorus, must be supplied to the soil, by the farmer, whenever it becomes deficient in quantity. That plants invariably derive it from the soil, is proved by the fact that no compound exists in the atmosphere which can furnish it. Sulphuretted hydrogen may sometimes be detected in particular locations, but it is not a substance universally present, or at all adapted in that state to supply the wants of vegetation.

Sulphur is without doubt derived from the sulphates, of which there are abundant sources in the earth and rocks. Sulphate of lime, or gypsum, is one of the most common sources for supplying this substance to vegetables. The sulphurets of the metals may also furnish it by decomposition. There is, therefore, no want of materials from which sulphur may be obtained.

Sulphate of ammonia is regarded by Liebig as the substance best adapted for assimilation in the vegetable tissue. This opinion is founded upon the composition of this body. It contains nitrogen; and as nitrogen is also a constituent of fibrin and albumen, it furnishes both elements by decomposition. The simple removal of the elements of water, hydrogen and oxygen, enables the nitrogen and sulphur to pass over into the composition of the vegetable juices. In the case of gypsum, inasmuch as it is soluble in water, it may also be taken up by the roots of plants, and in their juices undergo decomposition in the presence of carbonate of ammonia.

The sulphurous, or, as they are usually termed, nitrogenous compounds, albumen and fibrin, are insoluble substances, out of the animal body, or after coagulation by heat. It is supposed that, in plants and animals, their solubility is maintained by the presence of the alkalies. The white of egg furnishes invariably free soda.

In all the changes and facts respecting the state, condition and growth of vegetables, it is not difficult to see the mutual adaptations of bodies to each other. In the case of sulphur,

these adaptations are of the most interesting kind. Sulphur is one of those bodies which exists in its simple and elementary condition in the vegetable and animal fluids. It is a rare instance, as most of the solid or fluid bodies are oxygenated, or otherwise combined with other elements. Sulphur, whenever it is procured by the burning of vegetable substances, is obtained in the form of sulphuric acid, oxidation having taken place during the ignition of the vegetable.

IRON, OXIDES OF IRON.

Iron is an essential constituent of the blood of all vertebrated animals; but whether it is equally essential to the invertebrata, has never been determined. It is sufficient for my purpose to know that it is found in all animals with red blood. Of its source or origin there can be no doubt: all soils contain it, and all vegetables have the power to take it up. From the vegetable kingdom, it finds its way into the animal. What special function does it perform in the soil?

As in many other instances, so in the case of the oxide of iron, its function is not to be considered as confined to the production of one single result. In the vegetable economy, its office must be regarded as the same; but in the soil, it undoubtedly aids or promotes the formation of ammonia. To understand the mode by which this result is brought about, we must consider that iron exists in two states, viz. in that of a protoxide and that of a peroxide. This fact has been fully established by many analyses; but there is no constancy in the relative proportion of the two oxides: these are found to vary. The two oxides are made to play conflicting parts. When the iron is at its maximum point of oxidation, organic matter in the soil robs it of its oxygen, and the formation of an organic acid is the result. When, however, it is in its lowest state of oxidation, its affinity for oxygen is so strong that it robs water of that element; and the hydrogen, being set free, combines, while in its nascent state, with the nitrogen of the air in the soil, and forms ammonia. This will be dissolved in water, or may combine with any free acid, as the carbonic or sulphuric, when it is fitted for the uses of vegetation, or is ready to enter the vegetable tissues. Such changes may be carried on so long as the soil is furnished with organic matter. The presence of iron, then, aids in furnishing ammonia; and were it of no use itself in the vegetable and animal economy, its function would still be highly important.

The proto-salts of iron are usually regarded as injurious to vegetation. This is certainly true when they exist in considerable quantities, yet in small doses they do not destroy vegetation: hence the injurious effect of a proto-salt may be owing rather to the quantity, than to its poisonous properties. These salts are, however, easily neutralized by the application of lime. A barrenness arising from an excess in quantity of these astringent salts of iron, may be immediately remedied by an application of the hydrous subcarbonate of lime, by which gypsum is at once formed, and the iron remains a simple protoxide with the powers and functions ascribed to it in the preceding paragraph.

MANGANESE, OXIDE OF MANGANESE.

It is not as yet determined that this oxide is an essential constituent of any class of plants. So far as this question has been investigated, it appears to be an accidental substance in the ash of plants. Like iron, it is soluble in organic acids, and forms an earthy black substance, the particles of which cohere but slightly. It is analogous to bog ore, being formed in the same way and in similar locations. The organic salt of manganese is undoubtedly the substance which is taken up by the roots of plants, and is occasionally detected in small quantities by appropriate tests.

POTASH.

It is now well known that soils destitute of potash are nearly barren; that, at least for the cultivation of some plants, they are totally worthless. LIEBIG has proposed to divide plants into groups or classes, according to the predominance of a particular earth or alkali. This has some show of a systematic arrangement; but when it is attempted to carry it out, it fails, as generally in the composition of the seed we find potash; in the leaves and stalks, lime, etc. If the whole plant is taken into consideration, it is difficult to determine whether it should be called a lime, potash, soda, magnesia or silica-plant.

The original source of potash, and indeed of all the alkalies, is found in the rocks, particularly clay slate, and those containing felspar. In the Hoosic roofing slate 3·52 per centum of potash exists; in a slate of the same age in Washington county, 0·60. Marls and clays contain 0·50 to 1 and 2 per centum of potash and soda; but one of the shales from the Chemung series contains 5·47 per centum.* I have reason to believe, however, that this large amount of potash is only local; for it not unfrequently happens that a single specimen yields a large amount of some valuable fertilizer, as phosphate of lime; but a few yards distant, it is only in diminished quantities.

For analyses of the rocks, clays, marls, limestones, etc., see Vol. I. of the *Agriculture of New-York*. Numerous analyses are also given in the American Journal quoted below.

Potash, besides its direct use as a constituent itself of vegetables and animals, is equally useful, if not more so, in rendering silica and other bodies soluble. Its absence, or its presence in insufficient quantities, is an evil which must be removed by a direct application of those substances which contain it. Ashes of plants furnish it more economically than other substances. Even leached ashes contain potash, and are competent to impart fertility for many years; and in this condition, too, they give tenacity to loose and sandy soils. Our neighbors of Long Island understand well the value of leached ashes; while the farmers in the valley of the Mohawk have not yet discovered their use, and the fact that they would do much to restore to fertility the worn out fields in this beautiful valley.

* American Journal of Agriculture and Science, Dec. 1847, p. 343.

SODA.

Both potash and soda are bases for organic and mineral acids, in which combination they are connected with the growth and development of plants. The tubers of potatoes require both potash and soda, and, when grown in a suitable soil, they form a valuable food : if, however, they vegetate in the open air, a poisonous alkali is formed from the elements of the tuber, in which there exist mere traces of potash and soda.

The great source of soda is sea water and saline springs, where it is in combination with chlorine. It is also found in mineral bodies, in the same relations as those of potash : hence soils may be supplied with soda by the decomposition of slates, shales and clays.

It will be observed, on consulting the analyses, that soda is in less proportion in soils, rocks, and in the ash of plants, than potash. Plants growing in sea water and near brine springs, as at Salina and Syracuse, contain soda. The *Salsola kali* is common about the salt-pans and fields moist with chloride of sodium. It here finds its proper food, and is as flourishing as upon the shores of the Atlantic.

In rocks the percentage of soda is sometimes as high as 11·48, as in albite, a common variety of felspar; in mica, it is only from 3 to 5. Notwithstanding the apparent small percentage of soda in rocks and soils, we see that it has accumulated in immense quantities in some locations, as in the rock salt of Cheshire in England, Cracow in Poland, &c. The sea, however, forms the great reservoir.

It is maintained by many that potash and soda may replace each other, in case of an absence of either; that marine plants which naturally require soda, if cultivated far inland, take the vegetable alkali in place of the mineral. This, however, is a forced state; and the probability is, that in these cases the plant in a few years would cease to vegetate.

AMMONIA, VOLATILE ALKALI, HARTSHORN.

Ammonia, like potash and soda, is an original constituent of the globe; but unlike those alkalies, it is constantly produced and destroyed by the affinity of the elements which compose it. Nitrogen and hydrogen being its elements, may unite whenever they exist in a complex substance, when that substance is decomposed. It is exhaled from animal and some vegetable matters in the process of decay, during which it is probably formed by the union of its elements, but in which it did not exist as ammonia when the decay began.

Ammonia is also exhaled from the deep interior of the earth. Its salts condense in and upon the fissures of the rocks near volcanic vents. Its vapor rises from the lagoons of Tuscany, in company with boracic acid. This fact, however, does not prove that it exists in masses and reservoirs in the interior of the earth : it may be formed in its bowels, by the decomposition of water and other bodies in which nitrogen is an element.

The importance which ammonia takes in the processes of agriculture, arises from the

presence of nitrogen, a substance essential to the composition of the nutritive elements, as albumen and fibrin. It is not the ammonia in its entire constitution which enters the tissues of plants, and exists in them as such : it is necessary that it should undergo decomposition, and part with its nitrogen, to combine with other elements for the purpose of forming the tissues. One of the salts of ammonia exists ready formed in the cereals, viz. phosphate of ammonia and magnesia. The bran is richer in this salt than the flour; and it is stated by chemists, that when horses have been fed upon bran for a considerable time, balls of phosphate of ammonia and magnesia form and accumulate in the large intestines. This circumstance, however, I believe is a rare occurrence.

Ammonia exists in the soil either as a carbonate or sulphate, according to circumstances: it exists also in a free state. Clay and oxide of iron both attract this substance strongly: they serve therefore to fix it, and prevent its speedy evaporation.

Ammonia exists also in the atmosphere, and is brought down in rain water and snow, from which it may be obtained by evaporation. This fact probably explains the adage, that "Spring snows are the poor man's manure."

An important means of fixing ammonia is furnished by the use of plaster or gypsum. Privies and stables are in a measure freed of ammoniacal odor by sprinkling plaster upon the floor, or about the place : this plaster becomes then doubly valuable as a manure. The ammonia decomposes the gypsum, by combining with its sulphuric acid. The farmer will always find it for his interest to employ plaster abundantly about his premises, or in all places where decompositions are going on.

CHLORINE.

Chlorine is united to sodium or sodium and water, or potassium, when it exists in organized bodies. It is one of the elements of common salt. It combines with many other bodies, as potash, lime, magnesia, ammonia, iron, etc.

Common salt has often been extolled as a manure or fertilizer : its effects, however, are not uniform, and hence conflicting opinions exist as to its true value in agriculture. It has also been highly spoken of as a remedy for worms and insects, but here opinions do not agree. It is probably more important to animals than vegetables. Chlorine is not abundant in grains and seeds : it is more so in the stalks, leaves, etc. Clover contains more than wheat. It is not improbable that much chlorine is lost in the process of burning. We know that salt volatilizes by heat, or is carried off in the vapor of boiling water; hence, in this combination, it is undoubtedly lost in part.

Chlorine exists in the soil in combination with sodium. In the vicinity of the sea, its presence is readily accounted for by the spray and vapor carried inland by winds, which, when very strong, have been known to carry a quantity sufficient to impart a saline taste to leaves, grass, etc. to the distance of many miles. So it may be transported in a state of more minute division from sea to sea, though it is only over or near the ocean that the atmosphere is sufficiently charged to denote its presence by nitrate of silver.

Hardness in well and spring waters is often due to the presence of the compounds of chlorine. Chloride of potassium forms an important element of tobacco; and indeed it is somewhat remarkable that both chlorides, that of sodium and that of potassium, exist together in such large proportions as they are found in this deleterious weed. One variety of tobacco was found by WILL and FRESENIUS to contain 8·53 of chloride of potassium. The stalks of hops contain 9·64 per centum. The *Saccharum officinarum* contains a much larger quantity; amounting, according to STENHOUSE, to 30 per centum.

CARBON, OXYGEN, HYDROGEN AND NITROGEN.

In various states of combination, these bodies constitute those forms of matter which are called *organic*. The most important, or those which are most generally distributed, are carbon and oxygen forming carbonic acid, oxygen and hydrogen forming water, hydrogen and nitrogen forming ammonia. In the present constitution of bodies, not one of these compounds could be dispensed with: they are universally diffused and present in some form or other, in the vegetable, animal and mineral kingdoms.

Carbonic acid is the source of carbon in plants. It is also the great solvent in nature for the hardest materials, such as felspar in granite. Its constant, though slow action, compensates for the rapid and powerful action of mineral acids. I have already alluded to this property of carbonic acid.

Water in itself, and as water, must be furnished to all living bodies, and there are but few substances in the mineral kingdom which do not require it; but when it is considered in its constitution and the decompositions which it is susceptible of, and the changes it can effect in other bodies, or in its actions and reactions, its influence and importance are exceedingly magnified and extended. The same may be said of ammonia, the great source of nitrogen in organized bodies.

I need not here dwell longer either upon these elements themselves, or upon their compounds*. Of carbonic acid, I would remark in this place, that I have some doubt as to the absorption of it by the leaves of vegetables; and even admitting that it is absorbed, I can not but maintain the position that the roots are the principal organs which convey it to the plant. Leaves may condense carbonic acid on their surfaces, without absorbing it. It is, however, a point upon which I do not propose to insist. The fact that it is necessary that it be supplied by the roots, I have no doubt will be readily admitted; and hence practically the materials which are capable of furnishing it, must be supplied where they are required.

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* See Vol. I, pp. 223 - 227 of the Agriculture of New-York.

ORGANIC MATTERS.

Fertile soils always contain organic matters. By this term, however, is not intended to be understood a definite compound, but a complex substance derived from the decay of organized bodies, and existing in various states from the recently dead vegetable leaf or stem, to the perfectly disorganized product or products which have been formed in the process of decay. These products become finally converted into organic acids, which are capable of uniting with bases, as potash, soda, lime, magnesia, iron, manganese, ammonia, etc. In the character of salts, these compounds are absorbed by the roots of vegetables; and they constitute, at least in part, their food, and minister to their growth.

Some theoretical chemists look upon the organic matter of soils as of little consequence. If, however, the subject is considered in all its bearings, I believe its importance will be conceded. There are important functions which organic matter performs in soil. In the first stages of decay, and indeed through all its changes, it is an absorbent of water and ammonia. Indeed, the absorbent power of a soil is in a direct proportion to its organic matter in a minute state of division. In this respect it ranks higher than clay: it preserves the porosity of soil; it is a source of carbonic acid; it aids in the decomposition of the peroxide of iron, by which ammonia is furnished. We therefore find it an active agent at all times, performing some of the most essential offices to the growing vegetable; offices, which, though they may not be regarded as vital, yet unprejudiced minds must admit are of the highest consequence.

SUBSTANCES PECULIAR TO THE VEGETABLE KINGDOM.

Starch. This well known substance is a product of many plants, in some of which it is quite abundant: this is the case with the potato, wheat, barley and oats. It consists of rounded grains imbedded in the cellular tissue, and entirely destitute of a crystalline structure. Starch is insoluble in cold water; and, hence, after the cells in which it is contained are ruptured, it may be washed freely, and obtained in a pure state. The starch which is deposited in the tuber of the potato, and in grains of the cereals, is changed by germination into sugar: this transformation is effected by the saccharine fermentation. This susceptibility of starch being converted into sugar, is turned to advantage by brewers, in the formation of alcoholic liquors. A seed, when it begins to germinate, absorbs water and swells up, and its temperature rises: it then absorbs oxygen, and evolves water and carbonic acid, and the starch gradually diminishes or changes into sugar. Soon the sugar itself disappears, by ministering to the growth of a sort of stem. The office of the starch in the seed, tuber and root, is to furnish nutriment, until the plant can obtain it by its radicle from the soil. So long, however, as the seed is kept in a dry place, its starch remains unchanged.

Lignin. Wood of plants. There are various forms of this substance; thus, the cells of

the tissues, the fibres of flax, cotton, hemp, etc. are nearly pure lignin. To this substance the coloring matter adheres when employed with a mordant, as the acetate of alumina. It is in consequence of this affinity that colors are fixed, and continue unchanged for a long period.

Gum. *Gum arabic* is one of the most important gums. It is soluble in water; is in brittle transparent pieces, but never exhibits a tendency to crystallization. Gum may be changed into sugar by means of sulphuric acid, and also by the vital action of the plant which produces it.

There is a great deal of interest in the question of the changes effected on starch in the vegetable tissues. The origin of lignin is traced back to starch. It is known that the grains of starch possess a structure quite different from those substances which are formed by affinity. They have a structure analogous to certain animal organs, as the crystalline lens of the eye; and starch, when its changes are carefully noted, suffers a gradual transition into lignin, the arrangement of the granules being such that they form fibrous tubes in which considerable unaltered starch still remains adhering to the walls of the fibre or tube*. This peculiar change may be better understood, when the composition of starch is stated: it is composed of twelve atoms of carbon, ten of hydrogen, and ten of oxygen. Starch also being formed of concentric layers, the outer one continually increases in density by the absorption of water from the inner layers: this forms a space within it, which may only constitute a cell; but, in contiguous granules, they may form continuous cells, or, in other words, a tube.

Starch is regarded as the first stage in the organization of tissues. It may also perform other offices: it may be changed into sugar or gum, acids, oils, coloring matter. Changes of an analogous kind continually take place in the ripening of fruit. Let any one note the changes in an apple, or a nut, from its earliest period up to the perfect fruit, and he will witness numerous distinct products at different periods, which are changed or metamorphosed into each other.

Dextrine. This is regarded as a kind of gum, which is formed from starch. It is formed by digesting starch in sulphuric acid. The proportions employed, are, one of sulphuric acid, fifteen of water and five parts of starch; the mixture being heated to 200° Fahr., and maintained at that temperature for some time. The starch is perfectly dissolved, loses its peculiar character, and, instead of giving a deep blue violet color to iodine, imparts to it only a wine red.

Extract, or *Extractive matter*. Extract is a watery solution of several substances, dried down to the consistence of syrup. It is bitter and astringent usually, or sweetish bitter; but it can not be regarded as a proximate principle. It is an impure mixture of several substances. Many medicinal substances are obtained in this state, but they can never be regarded as chemical substances. The bitter principle of aloes, of hops, and of various roots, are complex bodies. Their composition always depends upon the mode in which they are prepared.

* Kane's Chemistry, p. 652.

Coloring matters. Coloring matter, as obtained, exists in two states : it is, first, a pre-existing substance of a particular vegetable; and, secondly, it is one which is formed by the chemical action of another substance upon a given vegetable product. Madder is an instance of the former; and perhaps indigo, of the latter. This substance, it is true, preëxists in the leaf of the *Indigofera* in a white condition, and so remains until the leaf begins to decay, when the white indigo absorbs oxygen from the atmosphere, which is known by the appearance of many blue points in the texture of the decaying leaf.

ALBUMEN, FIBRIN, CASEIN.

It is not my purpose to eulogize the age, or the men of the age; still it is a just tribute to science, and to men devoted to science, to say that the discovery that the three organic productions under consideration are indentical in composition, is really one of the greatest in modern times, especially when coupled with the fact that they are also identical with bodies of the same name derived from the animal kingdom. Vegetable albumen is the same as animal albumen, in composition. This discovery points out the source of these important bodies, and establishes clearly the offices delegated to the vegetable kingdom, namely, the elaboration of the fit elements of food, or nutrient matters, leaving the formative functions only to the animal; the power of shaping or moulding them, to the necessities imposed by nature. The animal consumes or eats what is essentially his own flesh, which is duly prepared in the grass of the fields. This subordination of the vegetable to the animal kingdom, is the greatest proof of design : it supports fully the doctrine maintained by PALEY.

ALBUMEN. The animal and vegetable fluids abound in this substance. In the white of the egg, and indeed in all eggs and in all animals, it exists in its greatest purity. Without undergoing chemical changes, albumen may be said to exist in two states; one soluble, and the other insoluble. The first state is the natural one : it passes into the other at the temperature of 167° Fahr. If albumen is carefully dried at a temperature not exceeding 120°, it still retains its solubility, and may even be exposed, when thus dried, to a temperature of 212° without losing its solubility. When it is exposed to a temperature of 167°, it coagulates, and then becomes nearly insoluble. Acids also possess the power of coagulating it, except the acetic, tartaric and phosphoric acids, in each of which it is perfectly soluble. So also the alkalies and their carbonates form soluble compounds with albumen.

Albumen is usually detected in fluids by the application of heat. The addition of nitric acid also coagulates the albumen.

The four organic elements, carbon, hydrogen, nitrogen and oxygen, together with sulphur and phosphorus, constitute this body. The proportions which are given are

$$C_{400}+H_{310}+N_{50}+O_{120}+SP.$$

The albumen of the blood differs from that of eggs, in containing one atom more of

sulphur. The salts contained in albumen amount to from 4 to 8 per centum, consisting of phosphate and sulphate of lime, and chloride of sodium.

The importance of albumen is directly indicated by the phenomena which occur in the incubation of the egg. It is a familiar fact, that in this process, all parts of the animal are developed from the albumen, inasmuch as no other nitrogenous body is present. Bones, muscles, feathers, nails, claws, the brain, the membranes and tissues of the body, and the blood, are all generated from this substance in a few days. The yolk is albumen intermixed largely with large yellow oil globules.

Fibrin. Fibrin is so closely allied to albumen, that it is regarded as chemically the same, although it presents some physical properties not found in albumen; thus, fibrin coagulates spontaneously from the blood when it ceases to circulate. By fibrin, then, it will be understood that I mean that clot or coagulum which forms when blood is drawn from a blood-vessel. As it exists in this state, it is mixed largely with the coloring matter of the blood. When it is wished to obtain it pure, blood may be shaken in a bottle with bits of lead or tin, when the fibrin will adhere in a fibrous mass, which may be washed with cold water till all foreign matter is removed. The fat which still adheres to it, may be dissolved out by ether. It is then a substance of a pale yellow, and devoid of taste or smell. Its chemical composition is the same as that of albumen. The fat associated with fibrin varies from 2 to 4 per centum.

Fibrin, like albumen, is always associated with a certain amount of salts. It is readily distinguished from other bodies, by its spontaneous coagulation.

Casein. Casein is an important constituent of milk. Curd of milk is casein combined with some foreign matters. To obtain it pure, milk is evaporated to dryness, and its butter dissolved out with hot ether. Dissolve the residue in water, and filter, and then throw down the casein with alcohol. When a solution contains casein, a pellicle forms upon the surface when heated or boiled: this is regarded as the effect of oxygen upon it.

The composition of casein, according to Mulder, is

$$C_{400}+H_{310}+N_{50}+O_{120}+S.$$

Casein is converted into albumen by digestion; and so, by the same action, albumen is converted into casein. It is precipitated from its natural solution by all acids, but is redissolved by the same. The most familiar case of precipitation, or rather coagulation of casein is that produced in milk by the mucous membrane of a calf's stomach: this is the method employed in the manufacture of cheese. The addition of an alkali to the milk would prevent coagulation. When milk is allowed to stand for some time, a naturally coagulated casein surrounds the butter vesicles, which are broken by agitation in stirring or churning, and collect in the form of butter.

Casein contains from 3 to 8 per centum of ash after incineration, consisting of phosphoric, carbonic and hydrochloric acids in combination with lime, magnesia and iron. To distinguish casein from albumen, it may be heated to a little over 167°, when it does not coagulate, but a pellicle will be formed upon the surface.

The three preceding substances, viz. albumen, fibrin and casein, are called *proteine bodies*; protein itself being regarded as a mere modification of them. They exist ready formed in the juices of vegetables, and may each be separated by suitable methods. Thus, juices which are newly expressed, and allowed to stand a short time, will separate into two or more parts: one is a green gelatinous precipitate, which, when the coloring matter is removed, is a grayish white substance, and has been named *vegetable fibrin*. It separates from the juices, precisely as does the fibrin of the blood. So the clarified juices of all nutritive vegetables, among which we may enumerate asparagus, cauliflower, cabbage, turnip, oats and the various other kinds of grain, when boiled, produce a coagulum which is identical in composition with the serum of the blood, or the white of an egg: this is called *vegetable albumen*. In the leguminous vegetables, as peas, beans, etc., the other proximate element, casein, more particularly abounds. This, as has been already observed, forms a pellicle upon the top of the heated juices, and does not coagulate.

These substances, too, I may add, are the chief constituents of the blood, and hence must be regarded as the proximate bodies which build up and form the basis of the animal frame.

Protein is obtained from either albumen, fibrin or casein. In order to effect this, the substance must be well washed in succession with water, alcohol and ether, by which means the extractive matter, soluble salts and fats are removed. The phosphates of lime, and other salts insoluble in water, are removed by hydrochloric acid. Potash in solution in water, and moderately strong, dissolves the remaining earths, as well as the sulphur and phosphorus which is usually present. The protein is then ready to be thrown down by acetic acid, which must be added in slight excess only. It is a gray gelatinous flocky substance, which must be washed from the acetate of potash upon a filter. When dried, it becomes hard and yellow. It is insoluble in water, alcohol or ether, and devoid of taste or smell. Its composition is represented by the formula

$$C_{40}+H_{31}+N_5+O_{12}.$$

Its symbol is Pr. It burns without leaving a residue.

Protein may be obtained from most of the tissues or organs and fluids of organized bodies. Thus besides pure albumen, fibrin and casein, it may be obtained from hair, horn, and the crystalline lens of the eye. It is regarded by Mulder as the first product of organization: hence the term *I am first;* and it is regarded, of course, as the starting point of the tissues in the animal kingdom. The relations of protein to the acids need not be stated here: it is sufficient for my purpose to observe that it dissolves in dilute acids, especially the acetic and phosphoric. It is precipitated from them by tannin, absolute alcohol, ferrocyanide of potassium, etc.

In regard to protein, I would, with great deference to the opinion of chemists, question the real existence of this body in the fluids or tissues in an insulated state, or one which exists independently of all other bodies. I do not question the product itself, or that such a product is readily obtained; but that it is ever formed or found in the fluids or tissues as

a product of organization, I do not believe. I may illustrate my views in this way : Bone is a homogeneous product of organization : so is fibrin, casein, etc. When these bodies, however, are washed with water, alcohol and ether, the extractive matter, fat and oils are removed. If we now subject them to the action of hydrochloric acid, we remove the solid matters, and we have remaining a flexible cartilaginous body of the original shape of the bone. So if we subject bone to incineration, we remove all but the solid parts : we have the earthy matters remaining. In this case, neither the cartilage nor the solid phosphates could say 'I am first;' for the fact is, the fluids, which form bone, contain simultaneously the special elements which are destined to form it. So it may be said of protein, that it never forms a tissue in its independent capacity : the elements of protein, as given in the formula, must be in combination with other bodies in order to form the tissues. These elements are all removed by the treatment to which the juices, tissues, etc. have been subjected. Cartilage of bone is far more likely to be formed in a state free from phosphate of lime; this, however, would be an abnormal state. So bone not unfrequently contains too much bony matter; and both bone and cartilage may be insulated by proper treatment, yet no one would have a right to call either normal bone. The insulation of protein from albumen and fibrin or casein, is an extraction by chemical affinity analogous to cartilage in bone; a matter, which never exists in an independent state. If, from proteine bodies, the fat and extractive matter is removed, leaving the inorganic substances, I believe it is in the condition in which it forms tissues. Fat, starch, oil, sugar, and analogous bodies, are the only ones which are destitute of inorganic matter. Even starch leaves a residue on burning, but I am unable to determine whether it is accidentally present or not.

The foregoing bodies exist in the animal and vegetable kingdoms. There are other bodies, however, which are found only in one : thus, gum and starch belong to the vegetable kingdom exclusively; while gelatin, or rather gluten, and chondrin, are products of the animal kingdom only. So pus or pyin, pepsin, and ptyalin, are also exclusively of animal origin. Only two of these bodies require a notice in this place, viz. gluten and chondrin.

Gluten. In its ordinary state and condition, it is gelatin or glue. Two distinct substances, closely related to each other, are obtained from skin, cartilage and bone, namely, gluten and chondrin. The former is obtained by boiling serous membranes, skin, etc. in water : when cold, it forms a tremulous jelly. Chondrin is obtained by boiling the cartilage of the ribs, or larynx : when cold and dried, it is hard and brittle. Both bodies behave alike when their solutions are treated with acetates of lead, sulphate of iron, chlorine and iodine : they form precipitates, which are not soluble in an excess of the precipitating substance. Alcohol also precipitates gelatin from its solutions. Tannin (tannic acid) is the proper test for gluten or chondrin.

Glycicoll is a species of sugar produced from gelatin, by boiling it with potash : it is the sugar of gelatin, and crystallizes in colorless rhombs from a spirituous solution.

The origin of gelatin is unknown, except that it is an animal product. It leaves a residue on being incinerated. It is supposed, however, that it is formed in the organism by the

decomposition of protein by the alkalies. Neither chondrin nor gelatin yield protein when treated with potash, as they do not become purple with hydrochloric acid. Gelatin does not contain fibrin, albumen or casein. Blood, therefore, can not be formed from gelatin; and hence an animal, fed exclusively upon it, must die from starvation. Though proteine compounds can not be evolved from gelatin, yet gelatin is formed from the proteine bodies. We have an example of such a production in the chick in the egg.

BLOOD.

It is a compound substance, though homogeneous when flowing either in its appropriate vessel, or in the moments during which it is issuing from a wounded vessel. When it has stood a short period, however, it separates spontaneously into three parts: serum, which is a yellowish somewhat viscid fluid; fibrin, a fibrous white coagulated mass; and blood globules of a red color, which, when circulating, impart a scarlet red to the whole mass. Blood, however, is not necessarily red: the white fluid of mollusca, and other invertebrate animals, is a true blood. It is also of different colors in insects and worms, as green, yellow, orange.

The temperature of blood varies in different classes of animals: in the ox, it is 103°; in the hog, 99·5°; horses, 96·8°; sheep, 101·3°; and the duck, 105·8°, being uniformly higher in birds than in mammalia. Arterial blood is 1·8° higher than venous. Its specific gravity varies from 1·041 to 1·082. In robust men, it is high; in very young infants, thin, and of a low specific gravity.

The function of the blood is to transmit nutritive matter to the various parts of the system. It must be nutritive itself; and as there is a continual waste in the system, it must necessarily receive continual additions: these are furnished by digestion, or, in vegetables, from matter taken up by the roots. The nutritive matter of blood consists of *plasma*, as it is sometimes called, and which is itself composed of albumen, fibrin, casein, fat, salts, iron, extractive matter, and a peculiar coloring substance called *hæmaphæin**. These constituents, however, are not all nutritive. As certain bodies are carried out of the system in a healthy state, we are to regard them as in a condition unsuited for nourishment: thus saline, coloring and extractive matter are excreted; while albumen, fibrin, and fat, never are, except in a morbid state. They neither are found in sweat, urine or mucus.

The nutritive power of the blood depends upon the food, and the health or normal functions of the system. We may form some opinion upon this subject, from the composition of blood from a horse.

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* Simon's Chemistry, Vol. I, p. 101, 102.

ANALYSIS BY SIMON.

	Arterial blood.	Venous blood.
Water	760·084	757·351
Solid residue	239·952	242·649
Fibrin	11·200	11·350
Fat	1·856	2·290
Albumen	78·880	85·875
Globulin	136·148	128·648
Hæmatin	4·872	5·176
Extractive matter and salts	6·960	9·160*

The testimony and opinions of many able chemists and physiologists go to establish the doctrine that there are important differences in venous and arterial blood. The following paragraph is a summing up of the differences, as established by careful experiments and analyses : "That arterial contains less solid residue generally than venous blood : it contains less fat, less albumen, hæmatin, extractive matters and salts, than venous blood ; and also that the blood corpuscles of arterial blood contain less coloring matter than venous"†.

It must be evident that blood can possess no definite composition ; that the blood of two individuals must be somewhat dissimilar ; and probably that the period of life, food, etc. must particularly modify its composition. It is well established that the condition of the organs materially affects it. Food which is intended to impart strength, must be rich in vegetable fibrin and albumen. Animals which are worked, or which afford milk, must be supplied also with the same materials, with food which contains elements of the composition of their own flesh.

The composition of different parts and organs of animals may be stated here, and in this connection, from the bearing which the subject has upon the growth and renewal of tissues.

Composition of bones, cartilage, teeth, muscles, liver, brain.

BONE.

	Femur.	Occipital bone.	
Phosphate of lime, with a little fluoride of calcium	54·07	52·51	
Carbonate of lime	12·71	11·14	
Phosphate of magnesia	1·42	1·05	
Salts	0·80	0·50	
Cartilage	29·09	32·80	
Fat	1·91	2·00	Von Bibra.

* Simon's Chemistry, Vol. I, p. 194. † Ditto, p. 195.

CARTILAGE OF A CHILD.

Phosphate of lime	20·86	
Sulphate of lime	50·68	
Phosphate of magnesia	9·88	
Phosphate and carbonate of soda	traces.	
Chloride of sodium	9·37	Henz and Gugert.

FROM THE COSTAL CARTILAGE OF A MAN TWENTY YEARS OF AGE.

Per cent of ash in the cartilage	2·24	

Dried muscle of the ox has the same composition as blood. It is composed of

	Beef.	Blood.	
Carbon	51·83	51·95	
Hydrogen	7·57	7·17	
Nitrogen	15·01	15·07	
Oxygen	21·37	21·39	
Ashes	4·23	4·42	Playfair.

The constitution of teeth is rather different from that of ordinary bone.

	Enamel.	Osseous portion.	
Phosphate of lime with fluoride of calcium	89·82	66·72	
Carbonate of lime	4·37	3·36	
Phosphate of magnesia	1·34	1·08	
Salts	0·88	0·83	
Cartilage	3·39	27·61	
Fat	0·20	0·40	Von Bibra.

COMPOSITION OF GLANDULAR MATTER — LIVER.

	Healthy liver.	Fatty liver.	
Water	76·39	55·15	
Solid matter	23·61	44·85	
Animal matter dried at 212°	21·00	13·32	
Saponifiable fat	1·60	30·20	
Cholesterin	0·17	1·33	Bondet.

The brain is composed of

Water	78·0	
Albumen	7·3	
Phosphorized fat	12·4	
Extractive matter and salts	1·4	Denis.

The quantity of water in the brain varies, according to the statement of several eminent chemists. According to Fremy, it amounts to 88 per centum.

It will be observed that from the foregoing analyses, the composition of the organs and parts vary essentially from each other; and though it may not be precisely the same in individuals at different times, still the departure from a certain standard is never very wide. The law of the vital economy secures a composition constant within narrow limits.

MILK:

A secretion of the mammary glands, of a white color, and, like the blood, is of a complex constitution.

Milk, when pure and healthy, has an alkaline reaction. This alkaline reaction continues for periods varying according to the state of the weather, and the meteorological condition of the atmosphere. The kind of milk, also, varies in this respect; human milk remaining longer in its alkaline condition than cow's milk.

Milk consists of casein, a coagulable fluid in which fat vesicles may be observed under the microscope. In addition to the casein and butter, certain salts and sugar are invariably dissolved in a large quantity of water. When milk is allowed to stand, the fat vesicles or butter rise to the surface. When boiled, casein rises to the surface and forms a pellicle. The same substance is coagulated by rennet, sulphuric and other acids. The solid matter of milk is composed of the following substances:

	I.	II.
Phosphate of lime	47·1	50·7
Phosphate of magnesia	8·6	9·5
Phosphate of peroxide of iron	1·4	1·0
Chloride of potassium	29·4	27·1
Chloride of sodium	4·9	5·0
Soda	8·6	6·7

The fluid matter of cow's milk has the following constitution in 1000 parts:

	I.		II.	
Water	857·0		853·0	
Solid constituents	143·0		177·0	
Butter	40·0		38·9	
Casein	72·0		69·8	
Sugar and extractive matter	28·0		31·3	
Fixed salts	6·2	Simon.	7·0	Herberger.

The milk may be diseased, by the general disease of the animal. When the cow has *vaccinia*, or vaccine disease, the butter is diminished, and pus is found mixed with casein. The milk from a healthy teat contains no pus, and has the appearance of healthy milk. Cows affected by the grease, do not yield healthy milk.

Milk is also liable to certain changes which can not be explained very satisfactorily. It sometimes becomes blue and yellow, from the presence of two species of animalculæ: the

first is the *Vibrio cyanogenus*, and the other *Vibrio xanthogenus*. I have also seen a bright red, from the presence of another species probably of the same genus. One or two pans of milk in a dairy will be affected, and all the rest escape.

Milk becomes sour, by the change of the sugar into lactic acid.

RECAPITULATION.

A brief notice of the foregoing substances was necessary for various reasons. The agriculturist should know the destination and use of those elements of the soil, the channels through which they pass, and the preparation they undergo before they are converted into products suitable for the consumption of man and animals. He should have in his mind a condensed scheme of the physiology of the natural products, and of the changes which the elements undergo in passing from their comparative inert condition in the soil, to their first semi-organized state in the tissues, and finally to their perfect organization in the bone, cartilage, membrane, muscle and brain.

In order to reproduce the foregoing matter in a distinct and more intelligible form, and in conclusion of the chapter, I shall here recapitulate the most important facts and principles.

1. Soil is composed of a few essential elements only; the most important, in one sense, the sense in which they are most necessary for animals, are in the smallest proportions.
2. If plants have no power of selecting the elements essential to their growth, they have the power of distributing it to certain parts and organs. Phosphate of magnesia and lime exist only in small quantities in the chaff of wheat, but both are quite abundant in the kernel which the husk envelopes. In no case do we find the reverse of this fact.
3. Every organ of a vegetable, and we may extend the remark to animals, has a reticulated frame work of inorganic matter, the base of which is either silex or lime. Monocotyledonous plants, particularly the cereals and grasses, have a silicious skeleton; the dicotyledonous have usually a lime skeleton, or a predominance of lime. This statement refers to the stalks, stems and leaves; while if their seeds or tubers are edible, their composition bears a resemblance to that of the grains.
4. The fluids of plants and animals contain all the nutritive bodies in solution, and become vitalized by contact with vitalized matter. A very large proportion of the fluids circulating in plants is water, the solvent powers of which are increased by the presence of alkalies and carbonic acid. It is by the presence of these bodies in the soil, too, that some substances quite insoluble out of the soil, are quite soluble in it: the organic matter of soils is soluble in most earths, and associated with other elements, and hence becomes an essential class of matters forming the growth and perfection of certain cultivated plants.

5. The importance of organic matter in the soil, is sustained by many well established facts:

a. In the removal of crops of beans, wheat, indian corn, etc., the soil is exhausted of not only inorganic but organic matter; and in order to restore fertility, experience proves the necessity of adding nitrogenous matters. The most striking results flow from those manures which contain the most organic matter already prepared for the uses of the plant, such as guano and night soil; and in the application of these substances, we become aware of the value of their presence in the soil. Ashes, which is usually regarded as a manure wholly inorganic, is really complex, and contains much organic matter. Organic matter in fact adheres so obstinately with phosphoric salts, as well as the alkalies, that no form of matter which is applied to land as a fertilizer is entirely free from it. If there are any exceptions, it is in the use of lime of the oldest rock, and in pure gypsum.

b. It is well established that one of the conditions necessary to secure the favorable action of lime, is the presence of organic matter. It is not sufficient that there be carbonic acid in the atmosphere, or ammonia: it is necessary that it should exist there in the condition of a product undergoing decay, by which the oxygenized products may be acted upon, and by which the peculiar organic acids may be produced.

c. In regard to the entrance of nutriment into a plant, I can not but regard the root as its channel. Experience upholds the idea at least; and though the leaf has the power of absorbing carbonic acid and ammonia, yet it is really analogous to the power of the skin also to absorb matters: still it is not the function of the skin to supply food to the system. Vicarious functions are quite different from natural ones. Hence the argument that organic matter in the soil could not furnish enough for the wood produced in a forest, does not prove that the forest received its increase through the channels of the leaves. The ammonia and carbonic acid falling with the rains to the earth, supply additions of nutriment to the soil. Again, it is not enough that the inorganic manures be employed. Experience proves that their good effect on crops fails in due time: indeed, perfect seed can not be produced in their absence. All essential and perceptible increase of products comes from manuring, and in proportion to the manure; and trees or shrubs whose branches are cut off from the supply below, die, not from the absence of water alone, but from starvation: they can maintain but a precarious existence under the most favorable circumstances.

d. The quantity of carbonic acid is about one-thousandth of the weight of the atmosphere. This is sufficient, no doubt, to preserve, so far as this is concerned, the balance of nature. Being produced by the respiration of animals and by combustion, and diffused through the atmosphere, it is again brought to the soil. So it is produced in vast quantities in the soil by slow combustion, and manures must yield the same product in the very place where it is particularly wanted.

Must we suppose that the carbonic acid thus derived from the decay of vegetables, and from the manures added, is evolved in a gaseous state, and ascends to the leaves for absorption? This will not gain credence.

e. So of ammonia : this must be continually supplied. The original store of it, which may be supposed, for argument, to have been thrown into the atmosphere, would long ere this have been exhausted. It must be reproduced, and it is well known to be reproduced in the decay of vegetables, and also that a part is resolved into nitrogen and hydrogen. The decompositions in the soil become a source of ammonia : this need not escape into the atmosphere for the absorption of leaves. Manures, too, furnish it during their changes in the soil ; and it is not probable that it must leave the soil in order to reach the vegetable tissue.

f. If, however, manure is left uncovered, will the crop get the benefit of it? Here it goes into the atmosphere ; but who will maintain that the field will yield the crop it would, had it been covered and well mixed with the soil? When ammonia is fixed by ground gypsum, is not the conclusion evident that it reaches the leaves of plants through the root?

g. The soil must possess *all* the inorganic substances, as well as organic, which are essential to the perfection of vegetables : if any one is wanting, it must be supplied. But to secure its benefits in the highest degree, the soil must be put into a state which shall make all those matters accessible to the roots of plants. This calls for the attention of the husbandman to its mechanical condition.

h. It is maintained that certain crops, as clover, take nitrogen from the air. May it not be doubted, and may not the advantages to be derived from its cultivation arise from its large and widely branching roots, whereby a rapid growth is secured by an absorption of nitrogenous matters from comparatively large areas.

6. Modern chemists and physiologists have established the doctrine, that the vegetable kingdom is the great source of nourishment to the animal kingdom. In the vegetable kingdom, albumen, fibrin and casein, substances essential to the maintenance of animal life, are elaborated. So both kingdoms yield back the inorganic matters to the mineral in their decay, and combustion and respiration are other means by which the food of plants is in part prepared. It will suggest itself to the reader, probably, that the actions of the vegetable end in results totally different from those of combustion and respiration. In the leaf, oxygen is set free ; in combustion, it is fixed. Oxygen and carbon being united in animal life, it becomes the part of the vegetable to separate them ; to appropriate the carbon in the growth of wood, while at the same time oxygen is once more in a condition to meet the wants of animals.

7. It is impossible to overlook, in these changes, the balance which is preserved by the controlling agencies of nature. Mutual adaptations prevail : harmony is secured. To the vegetable is allotted the task of elaborating the fluids most essential to the growth of animals. The vegetable has time and leisure to do this. To say that the plant vegetates, is to express the whole of its life and doings.

8. A large proportion of the weight of all living bodies is water : four-fifths of an animal is lost by drying. So also in some of the most important products of vegetable life, a very large amount has to be set down to water. These facts prove the importance of water; and it surprises every one, when he is told for the first time that highly organized animals, weighing twenty and thirty pounds, when dried, have only a few grains of saline ash : they are vesicles of animated sea water.
9. Many persons have been mistaken in their notions of scientific husbandry ; or they have failed to seize upon the higher idea embraced in the investigations of the philosophic farmer. We can regard scientific husbandry as an investigation of the mutual adaptations of the three kingdoms of nature to each other, and of the methods of applying fixed principles to practice. No other method of farming, but that founded on adaptations fixed in nature by its Great Author, can be successful, and repay the efforts of the laborer. Some of these methods are easily discovered, and have ever been used : others are not so accessible, and require other sources of knowledge for their discovery. Chemistry has in this way become the handmaid of agriculture, and has already unfolded new and most important principles in the employment of *this first and chiefest of arts.*

CHAPTER II.

ANALYSIS OF PLANTS.

GENERAL REMARKS ON THE IMPORTANCE OF AN ANALYSIS OF THE ASH OF PLANTS, AND ON THE DISTRIBUTION OF THE ELEMENTS OF PLANTS. PREPARATION OF THE ASH FOR ANALYSIS. MODE OF ANALYSIS : INORGANIC AND ORGANIC. ANALYSIS OF SEVERAL KINDS OF POTATOES IN COMMON USE; TOMATO. ROOT CROPS : CARROT, BEET, RUTA BAGA, SWEET POTATO. CONCLUDING REMARKS ON THE POTATO.

THE analysis of the cultivated, as well as of those vegetables which grow without cultivation, is a necessary work, and is especially promotive of agriculture in its present state. Modes of culture, preparation of the soil, and treatment of the growing crop, have reached a very perfect stage, and but little more can be expected from methods which are usually called improved. It has now become interesting to inquire how the produce may be increased, by improving the quality and excellence of the crop, by a systematic application of matters which the crop requires, by administering them in new modes and forms, and at times more in accordance with the period when peculiar elements are deposited in the seeds, grains or straw.

The possibility of bringing about improved results from the modes here alluded to, rests upon experimental knowledge of the constitution of the bodies we have under culture, and also upon the progressive changes and progressive accumulation of nutritive matter during the periods of growth. We obtain the knowledge necessary to secure the ends in view, by the analysis of the ash of the perfect and mature plant, and by successive analyses during its progress to maturity.

That the inorganic matters vary at the different stages of growth, is now well established; that organs differ in composition, and that the same may be said of parts, is no longer to be questioned. I shall maintain that these variations are not accidentally produced, but are results founded upon a law which regulates the distribution, and directs the final destination, of every particle of nutritive matter received into the tissues of a vegetable. If the distribution of nutritive matter had been left to chance, we might as frequently find the gluten and casein in the straw and chaff, as in the grains; the phosphates of magnesia, lime, etc. in the chaff, rather than in the kernel. Such a result has never been met with; the kernel being known as the principal storehouse of food, from the experience of the whole cycle of ages which has elapsed since their cultivation and use by man.

This law is one which may be expressed, so far as direction is concerned, by an upward

and outward movement : a peripheral force is given to the nutritive matters in the early stages of growth. It is perhaps premature to attempt to speculate upon the ends which are secured by the supposed law; but one or two remarks may be offered upon the subject. First, the products rich in elements required by all plants, are speedily sent back to the soil, for an early and renewed use : the leaf, the rind and husk, the tender stem, are all annual growths, and return annually to the soil to undergo decay. The fruit, with its envelopes, is situated at the extremity of a floral branch or bud : it is at the end of the channel of the coursing fluids; and its influence robs the base or bottom of the straw of a portion of its inorganic matter, that an accumulation may be secured in parts which are specially appropriated to the use of animals. The bottom of the straw has less nutritive matter than the top : it has moved upwards; but the usual supply is diminishing in consequence of age, and hence its deficiency remains to the end. Pea vines die upwards: their main stalk ceases to elaborate or arrest the nutritive matter; and it often presents the appearance of death, while the upper leaves and fruit are yet fresh : it is robbed by the activity of the superior organs. So numerous are the instances of this kind, that we can scarcely refuse to admit the law of an upward and outward force in the distribution of nutritive matters.

Another important result, is the perfection of the seed and fruit. This seems to be the great end to be secured; and so rare is a failure of this end, that we scarcely consider the law which secures the result : it is regarded as a matter of course. A stone projected into the air, surely returns to the ground, but the law of gravitation is rarely thought of; so the seed ripens by an accumulation of nutritive matters scarcely less surely, and, as in the case of gravitation, we forget there is any law in operation. Though a vast amount of nutritive matter is locked up in a forest, this law still operates. There is no centralization of important substances in the interior of the wood : in the growth even of the trunk of an oak of a thousand summers, the outward and upward forces, are still recognizable in the percentage of ash in the wood of the outside, the leaves, and extreme branches.

The action of vegetables upon the nutritive matters in the soil is in accordance with the same law : we can not fail to recognize the upward movement. The roots bring up, from the deepest parts of the soil to which they can penetrate, the acids and bases which are required to sustain life : the leaves and annual stalks receive a large share of it; these fall upon the surface, where they undergo decay; and hence upon the surface, the matter which has been drawn from the deepest soil, is left where it is required. We often see roots shooting upward into the richer stratum at the top; still, when not thus invited by a richer storehouse at the surface, they penetrate deeply and widely.

In the constitution of the soil, no depth has been reached, which has been on that account deficient in the elements of nutrition. Organic matter exists in the Albany clay, at the depth of at least fifty feet, and at hundreds of feet in the calcareous shale of the Salt group.

In confirmation of what has been stated in the foregoing paragraphs, the reader may

consult the analyses, many of which were undertaken with a view to determine the law of distribution of the inorganic matter*.

I now propose to give in detail the results of the analyses which have been made in furtherance of the objects of the State Survey. In doing this, I find it impossible to state these details in that complete and perfect form which is desirable. This arises from the fact that the analyses are still going on, will continue through this season, and can not be completed till its close. What then remains, will be given in an appendix to this volume.

The analysis of the ash of plants presents some difficulties which are not easily overcome. The first step is to procure an ash in a proper condition : if it is highly alkaline, it is very liable to fuse at low heat, and the fused particles embrace particles of coal, and the ash is black. So it is liable to be caustic, or partly in a caustic state; and hence there will arise, in summing up the results, an apparent error : the figure will be too high, if the carbonic acid is reckoned or calculated, instead of being obtained and weighed; it will be too low, if the carbonic acid is omitted. It is indeed difficult to obtain an ash entirely free from this uncertainty. The ash of indian corn is the most difficult to obtain; and, besides this, I take it upon me to say, that up to this time, no one has yet made a correct analysis of this grain, or without having too much loss.

The method which I have pursued for the analysis of the ash of plants, has been the one approved of by distinguished chemists. It has, however, been modified during the progress of the work; and if it has differed essentially from that of some distinguished chemists, it has been for special reasons.

I will now state the method which has been followed in the laboratory, in order that the results may be appreciated. When the method of obtaining a result is defective, I have no desire that it should pass for more than it is worth; and as the results given have been those which were actually obtained, it certainly is proper that the method also should be known. It has not been my practice, nor that of my assistants, so far as I have known, to distribute losses among the several results. The loss is a result as important as any, and should be known, and never concealed, however great it may be. That a small loss should occur, is inevitable; this will vary with the care bestowed, and the nature of the substance analyzed.

I. *The preparation of the ash.* The vegetable is burned at as low a temperature as possible, and sufficient time is given to consume the coal perfectly. Sometimes, however,

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* It is not intended here to claim the entire merit of determining the fact that the organs and parts of plants differ in chemical constitution, and differ also in different periods of growth. That the kernel differed in composition from the straw, has been known from the earliest times; but the differences which are very constant in the inside and outside wood of forest and fruit trees, the differences between the leaf and bark, the law of upward and outward movements of the nutritive fluids, were, so far as I know, first observed in my laboratory. Our results, however, were not published as early as some others bearing upon and proving the existence of the same general laws; but I do not, therefore, feel bound to credit discoveries in this field to others. By these remarks, it is not designed to claim more than is my due, nor to withhold praise from others who have labored in the same field. The present period has been remarkable for action and unremitting labors in the chemistry of plants, and many discoveries have been made almost simultaneously by different individuals.

the impure ash is weighed, and all the then soluble matters dissolved out, when the residue is again burned. This method is adopted only when the ash fuses at a very low temperature, or when the proportion of mixed alkalies is comparatively large. Generally the ash has been used soon after it has been prepared : if it stand it is dried previous to analysis.

II. The analysis begins with the weighing two or three parcels of 20 grs. each : sometimes a less quantity is used. One parcel is used for the earth, alkalies and phosphates; another for chlorine, sulphuric acid and organic matter. I obtain the chlorine from one half, and the sulphuric acid and organic matter from the other half. The other parcel is dissolved in hot hydrochloric acid. In many cases, this is a speedy operation : time, however, is given in the straw and chaff of the cereals, when silicates may be expected. We usually obtain in these cases a gelatinous solution, which indicates the perfect action of the acid. Silica is obtained by filtration : it is ignited and weighed. The filtrate contains the phosphates, lime, magnesia, potash and soda. The phosphates are thrown down by excess of ammonia; the lime, afterwards, by oxalate of ammonia. The filtrate, after the lime has been separated, is divided into two equal parts : one is used for magnesia; the other, for the potash and soda. To obtain the magnesia, I prefer the phosphate of soda with ammonia. We have used the peroxide of mercury, and it saves time and some labor; but we have been better satisfied with the phosphate of soda. The half reserved for potash is evaporated, and the salt exposed in a Berlin capsule to low ignition. It is then weighed, and the result is set down as chlorides. These are dissolved out with water, and filtered; the filtrate is evaporated again, and the dry residue submitted to the action of absolute alcohol. The insoluble matter remaining in the filter, which is washed with alcohol, is dried, and heated rather strongly, and weighed and set down as chloride of potassium, from which the amount of potash is calculated. The chloride of potassium and magnesia being subtracted from the chlorides, gives the chloride of sodium, from which the soda is calculated. The insoluble matter in water is also noted. This method, though not recommended in FRESENIUS's work, I can not but regard as quite accurate. FRESENIUS says that chloride of potassium is nearly insoluble in absolute alcohol; and we have found, on testing the alcohol made in the laboratory, that it does not dissolve a perceptible quantity of pure chloride of potassium, while chloride of sodium dissolves in it rather freely, and chloride of magnesia at once.

III. After going through with the preceding work, the phosphates which have been preserved are taken up for analysis. They are redissolved in hydrochloric acid, and filtered to free them from soluble silica. The filtrate from the soluble silica is mixed with ammonia in slight excess; and while the mass is still wet, acetic acid is added, which dissolves all but the phosphate of peroxide of iron : this is separated by filtering, and dried, ignited and weighed. From the filtrate, oxalic acid throws down the lime, which is also filtered, ignited and weighed. The magnesia is now thrown down by phosphate of soda and ammonia, the latter in slight excess, or else the acetic acid will still hold the magnesia in solution.

I can not but regard this method of treating the phosphate, as preferable to that where

the whole of the phosphoric acid is obtained at once and separately. If it is suspected, however, that we do not obtain all the phosphates or phosphoric acid, we adopt the separate method with another quantity of ash, using for this purpose a weighed portion of iron dissolved in nitric acid. By this method, all the phosphoric acid is obtained in combination with peroxide of iron.

By the method I have pursued with the phosphates, a more satisfactory result is obtained. We know not only what parts and organs contain the most phosphates, but also with what bases they are in combination.

The ash always contains organic matter. In almost every result we find it: it is, however, the most troublesome in the phosphates, and it has been suspected that it decomposes phosphoric acid, and that a loss ensues when strongly ignited. Whether there is a loss of potash in burning the vegetable, is not as yet well determined. The organic matter is supposed to exist as an organic salt of lime, magnesia, and perhaps potash. It seems impracticable to remove it, and it is quite abundant in the best or whitest ash which can be obtained. For a manure, ashes are so much the better for the organic matter: it is quite soluble in water, and its amount is obtained from the watery solution; the whole product being perfectly dried and weighed, and afterwards ignited till it is entirely consumed, it is again weighed, and the loss is organic matter.

It is hardly necessary to say that the chlorine is calculated from the chloride of silver, and the sulphuric acid from the chloride of barium. The proportions were obtained by taking 100 grs. (usually) of the substance, drying in a water bath, and then burning it in a platina or porcelain capsule.

Organic analysis, as detailed in the following paragraphs, consists in the separation of the proximate elements, as starch, albumen, casein, dextrine, etc. The mode is sufficiently simple, but seems to be liable to some variations in consequence of the easy decomposition of some of these bodies on exposure to the atmosphere.

The potato is first washed, and then dried, or freed from the outside water. It is then sliced longitudinally, and laid upon blotting paper a moment in order to absorb the exuded moisture. Two or three hundred grains are then weighed, when it is immediately grated carefully, and so as to be free from unbroken pieces of the potato. The grated portion is allowed to subside in pure water, after passing through fine muslin. The starch collects at the bottom; and the fibre, after thorough washing, remains upon the muslin filter. The supernatant liquor is drawn off from the starch by a syphon. The small quantity of fluid remaining upon the starch, and the starch itself, is thrown upon a filter and washed again, and the filtrate is added to the liquid drawn off by the syphon. The liquid is often quite bulky: it may, however, be divided into two equal parts; one for albumen, and the other for casein. The first is boiled or heated to above 160° Fahr., when the albumen separates in thin coagulated masses, and subsides in the course of twelve hours. This is filtered upon a prepared filter, and dried in a water bath preparatory to weighing. The casein is precipitated from the other half by acetic acid. The liquid, after complete subdivision, is drawn off with a syphon, and filtered, dried and weighed. The dextrine may be obtained

from either half. The acetic solution, however, must be first neutralized by carbonate of ammonia, when the albumen goes down, and from which the liquid must be freed. It may then be evaporated to a small bulk, and alcohol added in a large quantity, when the dextrine appears in flocculi which must be left to subside. It may then be filtered upon a prepared filter, and weighed. The remaining liquid is now evaporated in water, in a cup whose weight is accurately determined, until it ceases to lose weight : this matter is called sugar. The fibre which had been obtained in an uniform state, is freed from fatty matter and gluten by means of alcohol in a retort. Ether is afterwards employed to free the gluten from fat, which is cautiously distilled off or evaporated in a weighed cup.

My readers will now be prepared to set a proper value upon the labors which have been performed in the laboratory. The foregoing statements, I hope, have also prepared the way for entering upon a detailed account of the results which have been obtained. I shall, in the first place, give the analyses of the potato plant; and I may again say that the order of arrangements is governed by necessity, being obliged to give in the first place the analyses of those substances which are in the greatest state of forwardness; and as analyses are still in progress, and will be for three months to come, those which are made hereafter will be placed in an appendix.

The analysis of the potato plant is extended to the stalks, leaves and tubers; they have not been confined to the tuber. All the varieties which I could obtain have been analyzed.

I. MERCER POTATO.

Color white or grayish white; flesh white; form elongated, much longer than wide.

The potatoes analyzed were raised in Cortland county, by N. Salisbury, Esq. Length, 5 inches; thickness, 2½ inches.

1. *Analysis of the ash of the whole potato.*

Silica	4·400
Phosphates	38·500
Lime	0·150
Magnesia	0·800
Potash	13·263
Soda	24·925
Sulphuric acid	6·254
Carbonic acid	trace.
Organic matter	2·536
	102·434 S.

2. *Analysis of the phosphates.*

PHOSPHATES	38·500
Phosphate of peroxide of iron	7·900
Lime	2·933
Magnesia	0·055
Silicic acid	trace.
Phosphoric acid	27·612

For an analysis of the soil upon which this potato *grew*, see Vol. I, p. 342.

3. *Organic analysis of the Mercer potato.*

Size the same as that from which the ash was obtained.

PROPORTIONS.

Water of the ends	79·509
Dry matter in the ends	20·492
Ash of the ends	0·579
Ash calculated dry	3·746

ANALYSIS.

	Half from which albumen was separated.	Half from which albumen was not separated.
Starch	9·710	9·710
Fibre	5·779	5·779
Gluten	0·205	0·205
Fatty matter	0·084	0·084
Albumen	0·249	0·249
Casein	0·506	0·468
Dextrine	0·721	1·265
Sugar and extract	3·931	2·638
	21·185	20·398

It is found that the amount of water, ash, etc. differ in the ends of the potato. The following results exhibit this fact:

	1. Seed or rose end.	2. Heel end.
Per cent of water	83·839	75·177
Dry matter	16·161	24·823
Ash	0·725	0·431
Ash calculated dry	5·197	2·296 S.

These two results with the ends may be compared with the mean, or both ends used together. It becomes necessary, from these differences in the composition of the ends, to examine them separately when time will permit. The result is interesting, and agrees with other facts in the same class.

II. EARLY SHAW, MOUNTAIN JUNE, EARLY JUNE POTATO.

PL. 3 B. Fig. 2.

Color white; flesh white; form round; eyes in fives; skin slightly rough.

This is one of the most valuable of the varieties of this vegetable. It is not predisposed to rot, or to be impaired by the disease. It is early, and may be used as an early or late potato; and my own experience is that it keeps well, and is really one of the best kinds in the spring, *never* becoming watery or strong. If it is planted early, it reaches that point of maturity which enables it to escape disease. The cause which occasions the rot acts only upon the immature crop. A ripe potato is no more affected by the rot, than an apple, or any other fruit.

1. *Organic analysis of the tuber.*

	I.	II.
Water	74·902	75·06
Starch	13·378	10·45
Casein	2·053	0·73
Albumen	0·085	0·27
Sugar and extract	1·364	2·04
Dextrine	0·912	0·44
Gluten and fat	0·008	
Fibre	6·829	10·70
	99·531	99·69

PROPORTIONS.

Water	74·3598	
Ash	0·5492	
Dry matter	25·0910	
Ash calculated dry	3·4470	B.

The second analysis was made of a specimen obtained from Lansingburgh, from the garden of Mr. A. WALSH; and I have reason to suspect that the fibre was not thoroughly washed from starch.

The Early Shaw is a potato of English origin, and I believe has not been cultivated many years in this country. It never attains a large size; neither is it as productive as some other kinds, yet it is very excellent in its product. Its superior qualities render it a very desirable kind for general cultivation for the table.

2. *Potato vine — Early Shaw.*

Cut August 6, when it had just passed its flowering.

ANALYSIS.

Silica	3·500
Phosphates	9·250
Lime	17·797
Magnesia	7·080
Potash	24·074
Soda	none.
Chloride of potassium	9·444
Chloride of sodium	0·032
Sulphuric acid	13·748
Carbonic acid	none.
Organic matter	1·150

PROPORTIONS.

Per centage of water	90·54
Dry matter	9·46
Ash	1·48
Calculated dry	15·52 S.

3. *Analysis of the leaves of the Mountain June potato.*

Cut at the same time, and taken from the same stalks. Slight effervescence of the ash.

Silica	35·775
Phosphates	21·275
Lime	11·805
Magnesia	1·970
Potash	17·896
Soda	1·319
Chloride of potassium	none.
Chloride of sodium	5·593
Sulphuric acid	3·377
Carbonic acid	traces.
Organic matter	1·725

PROPORTIONS.

Water	80·360
Dry matter	19·640
Ash	3·900
Ash calculated dry	19·852

ANALYSIS OF THE PHOSPHATES.

PHOSPHATES	21·275
Lime	7·600
Magnesia	trace.
Silica	1·550
Phosphate of peroxide of iron	7·075
Phosphoric acid	5·049 S.

III. FLESH-COLOR OR BURR POTATO.

PL. 2 B. Fig. 2.

Color purple; flesh white; form wider than long; eyes elongated, and in fives.

In this analysis the whole potato was taken. Grown in the garden of Mr. WALSH, Lansingburgh.

1. *Analysis of the tuber.*

Silica	0·309
Phosphates	32·000
Lime	0·282
Magnesia	0·400
Potash	20·798
Soda	43·044
Chloride of sodium	3·924
Sulphuric acid	0·859
Carbonic acid	trace.
Organic matter	2·700
	104·247

2. *Analysis of the phosphates.*

PHOSPHATES	32·000
Phosphate of peroxide of iron	4·900
Lime	0·733
Magnesia	0·155
Silicic acid	0·155
Phosphoric acid	26·057

3. *Organic analysis.*

	I.	II.
Water	72·52	76·3260
Ash	0·68	
Starch	7·77	9·7850
Albumen	0·88	0·1203
Casein		0·9724
Dextrine	0·46	0·5015
Sugar	3·45	5·7630
Gluten		0·0407
Fat	0·18	
Fibre	9·74	8·1504

It will be observed that this potato contains less starch than many others in common use.

For the analysis in another specimen, a slice was cut through the middle of the potato from end to end. The following three proportions were made of the ends and middle.

	1. Rose end.	2 Middle.	3. Heel end.
Water - - - - -	78·977	76·328	74·918
Dry matter - - - -	21·023	23·672	25·082
Ash - - - - -	0·942	0·674	0·577
Ash calculated dry - - -	4·479	2·847	2·300

Mean per centum of ash of the two ends - - -	3·3895	Calculated dry.
do whole potato - - -	3·2086	
Mean per centum of ash in two ends - - - -	0·7595	Moist potato.
do in the whole potato - -	0·7310	
Mean per centum of dry matter in the two ends - -	23·0525	
do whole tuber - -	23·2590	
Mean per centum of water in two ends - - -	76·9475	
do whole potato - - -	76·7410	S.

IV. MERINO POTATO.

LA PLATA RED, LONG RED, LONG JOHNS, SPANISH RED.

PL. 5 B.

Color red; flesh white, with reddish circular patches in the direction of the reddish or purple axis; form greatly elongated; eyes numerous, and in 14.

This is one of the largest of potatoes: it has been known to attain a foot in length. It is also productive. Though not highly esteemed for the table, yet I believe it is a better potato than many others in common use, when served in its season. It ought not to be used till late in winter and early spring. Cattle are fond of them, as its flesh is tender and juicy. Like many other fruits, as apples and pears, this has its period when it is ripened for the table. It has not, however, been customary with the great body of farmers to select their potatoes in their proper periods, or those periods when they become ripened by age. A potato is obliged to be cooked and eaten at any time after harvest. I can not, however, but believe that the time is not far distant, when the different kinds will be used as they attain maturity; and as in the case of fruits, there will be distinguished the early harvest, the fall, winter, spring and summer potatoes. Accurate experiments upon their keeping qualities are needed, and the time when, like greening and russet apples, they become fit for use. I have subjected this variety to a careful analysis; but the ash which was subjected to examination was obtained from potatoes growing on a different soil from those from which the starch, albumen, etc. were obtained.

1. *Analysis of the ash of the Merino potato in three parts.*

	1. Rose end.	2. Heel end.	3. Middle.
Silex	1·586	4·019	1·658
Coal	0·180	0·612	
Carbonate of lime	0·070	0·060	0·984
Phosphates	14·533	20·842	23·714
Potash	50·213	48·855	38·708
Soda	13·713	15·066	18·518
Sulphuric acid	8·125	8·424	8·471
Chlorine	1·110	1·242	0·897
Insoluble	3·466		4·210
Organic acids	6·000	0·813	
Organic matter			2·830
Magnesia	trace.	trace.	trace.
	98·996	99·933	99·990

These analyses, it will be observed, are calculated without carbonic acid. The ash of the ends effervesced strongly; the middle, less so: in each instance showing the former existence of organic acids, which, by burning, had been converted into carbonate. The ash, however, in each instance, was converted in part into a caustic state. The potato, it is proper to say, was not peeled; but the outside was well cleansed from dirt by a brush, without abrading the skin.

2. *Organic analysis of the Merino potato.*

From the garden of Mr. WALSH, Lansingburgh.

	Middle.
Starch	13·755
Fibre	6·766
Albumen	0·112
Gluten and fat	0·284
Casein	0·605
Dextrine	0·556
Sugar and extract	2·773

MEAN PERCENTAGE OF WATER IN THE TWO ENDS.

Water	74·3865
Dry matter	25·6135
Ash	0·7165
Calculated dry	3·7685

PROPORTIONS OF THE TWO ENDS.

	Rose end.	Heel end.
Water	81·301	67·472
Dry matter	18·699	32·528
Ash	0·973	0·460
Ash calculated dry	5·401	2·136 S.

Another specimen of the rose end gave,

Water - - - - - - - - -	74·04
Ash - - - - - - - - -	0·94

As this variety is one of the best for illustrating the difference in composition of the different parts, I have divided it into three portions, viz. rose end, heel end, and middle. These divisions, however, are not exact by measure; three parts, nearly equal lengths, only being taken, without regard to exact lines of demarkation denoted by the position of the eyes.

It is evident from an inspection of the results of the analyses, that the ends differ from each other, and also from the middle. I had, however, too little ash in each instance, and not as much as is required for the most trustworthy analysis; still, on comparing them with the results of others, I find there is a sufficient coincidence to bear out the expectation that they approximate very closely to their true composition. I fear, however, that there is too great a difference between the middle and ends, or it may be that it is greater than will be found by subsequent trials; yet there is clearly a foundation for suspecting that there are real and permanent differences in their composition. The amount of water in the ends, and of solid matter, and the proportion of ash, are considerations which lead to the conclusion that these differences are not due to errors of analysis. The most remarkable differences are found in the amount of potash and of the phosphates.

It may be interesting to copy two analyses of P. F. H. Fromberg, assistant in the Laboratory of the Agricultural Chemistry Association of Scotland:

	Rose end.	Heel end.
Potash - - - - - - - -	38·15	29·53
Soda - - - - - - - -	5·40	11·26
Chloride of sodium - - - -	6·25	9·66
Lime - - - - - - - -	1·28	1·55
Magnesia - - - - - - -	5·90	3·96
Oxide of iron - - - - -	1·03	1·34
Sulphuric acid - - - - -	24·32	20·63
Phosphoric acid - - - - -	12·81	20·73
Silica - - - - - - - -	4·86	1·34
	100·000	100·000

In order to compare these analyses with my own, it is necessary to state that the lime and magnesia here given is in combination with phosphoric acid; and that in my own, those bodies are merged in the general composition of the phosphates.

V. COW-HORN POTATO.

Pl. 3 B. Fig. 1.

This is a small elongated potato of purple color, and usually slightly bent or curved. It is not in common use, but is esteemed as a very good baking potato. I have not been able to analyze it, but I have given a figure which represents the variety perfectly. It is a very good spring potato; and those who are fond of cultivating singular kinds, will add this to their number.

VI. CARTER POTATO.

Pl. 2 B. Fig. 1.

Color gray and yellowish gray, often tinged slightly with purple; flesh white; form elongated; eyes few, and in 5's.

This is esteemed as a rich variety, and is extensively cultivated for market, and usually bears a high price.

Organic analysis.

Water	74·00
Starch	11·92
Casein	0·55
Albumen	lost.
Dextrine	0·41
Sugar and extract	3·78
Gluten	
Fat	0·21
Fibre	7·02
Ash per centum	0·88

VII. PEACH-BLOW POTATO.

WESTERN RED, LAKE ERIE, SAND LAKE, BUFFALO, KENTUCKY RED.

Pl. 2 B, fig. 1.

Color red, and marked with numerous dots; form elongated; eyes few, and in 5's.

It has some resemblance to the Merino, but is of a brighter red and rarely as long. The quality of the Western Red ranks only with the medium kinds. It is a good bearer, and is common in the winter in the Albany market. It is not much affected with the potato

disease, especially upon the sandy lands between Albany and Schenectady. From the numerous names under which it is known, it seems to be cultivated in a large extent of territory, being common in New-England and in the Western States.

Organic analysis.

Water	73·78
Starch	12·60
Albumen	0·36
Casein	0.45
Dextrine	0·25
Sugar	2·22
Gluten and fat	0·18
Fibre	8·35
	98·19
Ash per centum	1·07

It yields more than an average quantity of starch.

VIII. HAVANA POTATO.

This variety is characterized by its elongated and tapering form. Two or three are often united at the smaller ends. It is not generally cultivated. Although it is of a medium quality, its shape is against it, and it will probably never become a favorite kind with farmers. From the garden of A. Walsh, Esq. Lansingburgh.

Organic analysis.

Water	75·15
Starch	8·93
Albumen	0·30
Casein	0·05
Dextrine	0·48
Sugar	0·60
Gluten	0·77
Fat	0·10
Fibre	8·41
Ash per centum	1·41

IX. LADY-FINGER POTATO.

Pl. 6 B, fig. 1.

The Lady-finger is eteemed for baking : it is an elegant variety, and might be considered a fancy potato. It frequently grows quite large and long, especially when planted in highly manured land. System of eyes in 14.

Organic analysis.

Water	78·07
Starch	8·25
Albumen	0·43
Casein	0·43
Dextrine	0·98
Sugar	2·31
Gluten	
Fat	0·09
Fibre	14·37
Ash per centum	1·03

X. EARLY KIDNEY POTATO.

Pl. 4 B, fig. 1.

Color grayish and yellowish gray, smooth ; flesh white ; form elongated ; eyes few, small, and in 5's.

It is a delicate early potato, but not very productive.

Organic analysis.

Water	73·13
Starch	12·91
Albumen	0·92
Casein	0·10
Sugar	3·29
Gluten	
Fat	0·05
Fibre	7·13
Ash per centum	1·47

XI. ORANGE POTATO.

Color yellowish gray, eyes slightly margined with pink; flesh yellowish; form roundish; eyes in 5's.

Organic analysis.

Water	78·44
Starch	8·05
Albumen	
Casein	0·35
Dextrine	0·17
Sugar	2·38
Gluten and fat	0·36
Fibre	8·05

A diseased specimen gave

Water	81·58
Starch	2·80
Fat	0·15
Fibre	9·65
Ash per centum	0·76

XII. SCOTCH GRAYS POTATO.

EARLY BLUES, STAFFORD HALL.

PL. 4 B, fig. 2.

Color bluish purple with yellowish patches, rose end darker than the heel end; flesh white; form elongated; eyes in 5's.

Organic analysis.

Water	71·63
Starch	9·28
Albumen	0·92
Casein	0·80
Dextrine	0·40
Sugar	3·64
Gluten and fat	0·40
Fibre	11·39
Ash per centum	1·12

The Scotch Gray gives a good result in its analysis. It is, however, complained of as disposed to become watery and rather strong.

XIII. PINKEYE POTATO.

Pl. 1 B, fig. 1.

Color orange gray; eyes purple, with a waved line; flesh yellow; form round.

Organic analysis.

Water	75·06
Starch	8·81
Albumen	0·17
Casein	0·60
Dextrine	0·68
Sugar	2·29
Gluten	
Fat	0·12
Fibre	8·77
Ash per centum	0·96

XIV. BLUE PINKEYE POTATO.

Bluish or purplish red, uniform; broader than long; flesh white; eyes in 5's.

The young tubers, obtained from the Albany Market, June 12, 1848; raised in New-Jersey.

1. *Organic analysis of* 300 grs.

		Per centum.
Water	221·15	73·71
Starch	63·43	21·14
Albumen	2·00	0·66
Casein	1·64	0·54
Dextrine	0·76	0·25
Fibre, gluten and fat	11·70	3·90
	300·68	100·20
Ash of the fibre	1·55	

2. *Analysis of the ash.*

Silex	2·000
Phosphate of lime, magnesia and iron	19·083
Magnesia	trace.
Carbonate of lime	0·200
Potash	40·767
Soda	
Chloride of sodium	23·452
Sulphuric acid	7·001
	100·503

XV. ROUND PINKEYE (YOUNG).

PL. 1 B, fig. 1.

Yellowish white; roundish but flattened, somewhat shorter than wide; eyes purplish, in 5's; flesh yellowish, uniform.

Obtained in the Albany Market, June 12, and was about two-thirds its natural size.

1. *Organic analysis of* 300 grs.

		Per centum.
Water	238·62	79·540
Starch	40·46	13·486
Albumen	1·58	0·526
Casein	1·75	0·583
Dextrine	0·36	0·120
Fibre, fat and gluten	12·50	4·133
	295·271	98·388
Dry matter	20·46	
Ash	0·78	
Per centage of ash of dry matter	3·81	
Ash of the fibre	2·05	

2. *Analysis of the ash.*

Silex	1·100
Coal	0·200
Phosphates of magnesia, lime and iron	27·761
Carbonate of lime	0·410
Magnesia	trace.
Potash	19·941
Soda	20·116
Chloride of sodium	25·447
Sulphuric acid	5·938

This analysis is calculated without carbonic acid or organic matter.

Soda, in this potato, greatly exceeds the potash, and the amount of phosphates is greater than is usually obtained. Probably the early potatoes are forced forward by the aid of rich manures, and hence the excess of phosphates and soda. This, however, is only a conjecture, which I have not the means of verifying.

XVI. ANALYSIS OF THE ASH OF THE YOUNG POTATO VINES (EARLY SHAWS).

I separated the leaves from the stem, in conformity with the method I have usually pursued in the analysis of similar substances.

1. *Analysis of the leaves.*

Quantity of ash used, 20 grs.

		Per centum.
Silica	5·500	27·500
Phosphates	4·090	20·450
Carbonate of lime	2·599	12·995
Magnesia	0·230	1·150
Potash	1·570	7·850
Chloride of potassium	2·061	10·305
Chloride of sodium	1·850	9·250
Sulphuric acid	0·448	2·240
Carbonic acid	0·731	3·655
Soluble silica	0·260	1·300
Organic matter	0·231	1·155
		97·850

2. *Composition of the phosphates.*

PHOSPHATES	4·09
Phosphate of peroxide of iron	0·90
Lime	0·73
Magnesia	2·08
Phosphoric acid	1·28
	4·09

XVII. ANALYSIS OF THE ASH OF THE POTATO STEM (EARLY SHAW). Effervescent.

	Per centum.
Silica	5·000
Phosphates	13·000
Carbonate of lime	11·700
Magnesia	0·560
Potash	20·740
Soda	2·000
Chloride of potassium	34·960
Sulphuric acid	4·000
Carbonic acid	9·032
	100·992

XVIII. GILKEY POTATO.

MERCER, CHENANGOES, MÉSHONNOC, NERCHANNECK.

The young tuber, obtained in the Albany market the 7th or 8th of June. They were only about half grown, or considerably less than when in market in their season.

Organic analysis of 300 grs.

		Per centum.
Water	243·00	
Starch	39·99	13·33
Albumen	3·38	1·12
Casein	3·64	1·21
Dextrine	1·81	0·60
Fibre, oil, sugar and gluten	11·85	3·95 S.

From this analysis it appears that this variety, when young, is as rich in nutritive matter as when mature.

The fibre gave ash 1·8143, or 0·6037 per centum; and consists of sulphate of lime, magnesia, and but a small proportion of phosphate of lime and magnesia.

Proportions of water and ash of young and old potatoes.

Young potatoes, 100 grs. gave

Dry	17·55
Ash	1·07
Calculated dry	6·09

Old set, 100 grs. inside gave

Dry matter	3·54
Ash	0·51

Old set outside, in 100 grs. gave

Dry matter	5·72
Ash	1·64

It will be observed, that in the old set, the inside is mostly water; that the water in fact increases, while the inorganic matter diminishes, and it probably goes into the young set in the condition of nutriment.

Proportion of water and ash in different parts of the vines.

1. Leaves of one stalk or vine, collected on the 12th of June.

		Per centum.
Quantity	781·50 grs.	100·00
Dry matter	93·10	11·88
Ash	16·03	2·05

2. Stalk divided in length into 3 equal parts : bottom, middle, top.

	Bottom.		Per centum.
Quantity	210·00	grs.	100·00
Dry matter	1·28		7·09
Ash	2·84		1·17
	Middle.		**Per centum.**
Quantity	186·70		100·00
Dry matter	8·73		4·68
Ash	1·68		0·91
	Top.		**Per centum.**
Quantity	77·200	grs.	100·00
Dry matter	3·440		2·65
Ash	0·408		0·53

Ash calculated dry.

	Ash.	Water.
Bottom	16·5	92·91
Middle	19·4	96·32
Top	20·0	97·35

XIX. HARPER'S POTATO.

1. *Analysis of the ash.*

Silex	1·118
Coal	1·132
Phosphates	11·111
Potash	50·094
Soda	7·607
Carbonate of lime	6·666
Magnesia	0·369
Phosphates of soda and potash	4·555
Chlorine	2·780
Organic matter	4·593
Sulphuric acid	7·321

2. *Analysis of the phosphates.*

Phosphates	11·111
Phosphate of peroxide of iron	0·308
Soluble silica	0·225
Lime	1·050
Magnesia	2·293
Phosphoric acid	7·238
	11·194

	PROPORTIONS.
Water - - - - - - - -	77·55
Dry matter - - - - - - -	22·45
Ash - - - - - - - -	0·79

This potato was introduced into this country by Mr. HARPER, from England, and is found to be an excellent variety, and very little subject to decay.

From the foregoing analyses, it will not be difficult to determine the exhausting powers of the potato crop. In doing this, it will be useful to consider the tuber only, as this is the part which is removed from the field. The stalks, I believe, almost invariably are left to decay upon the ground, and hence restore to the soil the substances they had taken from it during their growth. Sometimes, however, it may be an object with the farmer to put them into a compost heap, for the purpose of securing a more perfect decomposition than will usually take place upon the surface. In this case, it will be observed that the leaves and stem are rich in inorganic matter : potash, from 25 to 35 per centum. Chloride of potassium and sodium, as well as the phosphates of lime, magnesia and iron, form also important items in the ash, or inorganic matter. The tuber, however, being removed, and consumed often in a distant market, its elements are lost to the soil, and so far they exhaust it of important matters. But as the potato contains a large percentage of water, and a small amount only of ash, it would seem not to exhaust the soil rapidly; still when it is considered that a large amount is yielded, it will not escape our observation, that the loss to the soil is quite large. So also it will be observed that the ash is rich in those elements which it is expensive to restore, namely, the alkalies and phosphates, or bone earth as it is sometimes called. Nearly one half of the ash is potash. Hence it is evident that attention to the elements removed in the crop is of the highest importance.

The amount of elements removed in an ordinary crop of potatoes, may be stated as follows:

	In one ton of tubers.	Removed from an acre.
Potash - - - - - - -	8·40	42·00 lbs.
Soda - - - - - - -	3·00	15·00
Lime - - - - - - -	1·00	5·00
Magnesia - - - - - -	1·61	8·05
Phosphates of lime and magnesia - -	3·57	17·85
Sulphuric acid - - - - -	1·70	8·50
Chlorine - - - - - - -	0·21	1·05
Silica - - - - - - -	0·51	2·55
	20·00	100·00

Thus one hundred pounds of inorganic matter is removed from an acre in the course of an ordinary crop of five tons; and this is a low estimate, as fourteen tons of potatoes are frequently obtained from the acre. More than one half is potash and soda, and a large item consists of the phosphates of lime and magnesia.

In the potato crop, as in the grain crop, magnesia and lime are in combination with phosphoric acid; and it is only in a very small proportion that these important bodies appear in the form of carbonates in the ash, a form which is derived from incineration, and consequent change of the organic acids present in the potato.

It is necessary to remark here in regard to the estimates which are made of the removal of the inorganic matter, that no one variety could exactly represent the amount removed: there are small variations in the percentage of varieties. These variations, however, are not much greater than those which are furnished by the two ends of the same potato; a difference which is not accidental, but one by which important results are accomplished in the economy of this valuable plant.

If we consult the analyses of the potato for the purpose of determining the best mode of culture, or what manures are the best adapted to it, we shall readily be able to satisfy our minds; for it is evident that it is strictly a potash plant, and requires the use of those substances which are rich in this element. There is no doubt, therefore, of the value of ashes, in some form or other, to this plant; and it is highly probable the potash in the soil is the element which is exhausted first of all. A plant, however, which every body feels competent to raise, scarcely requires comment in this place.

Closely allied to the potato, is the *Tomato*, a vegetable which is already extensively cultivated, and is rapidly becoming more so. The vine and leaves have been carefully examined in the laboratory, and are found to possess the following composition:

XX. TOMATO VINES (THE LARGE RED VARIETY).

They were cut August 6, 1847, and were only half grown.

1. *Proportions of water, ash, etc.*

Per centum of water	88·39
Dry matter	11·61
Ash	1·68
Ash calculated from the dry matter	14·47

2. *Analysis of the vine or stem.*

Silica	4·720
Phosphates of lime, etc.	13·200
Lime	8·151
Magnesia	0·150
Potash	45·482
Soda	1·632
Sulphuric acid	0·336
Chloride of sodium	17·135
Carbonic acid	trace.
Organic matter	7·275 S.

3. *Composition of the phosphates.*

PHOSPHATES - - - - - - -	13·200
Phosphate of peroxide of iron - - - -	1·450
Phosphate of lime - - - - - -	3·243
Magnesia - - - - - - -	0·100
Silicic acid - - - - - - -	0·450
Phosphoric acid - - - - - -	7·957

COMPOSITION OF TOMATO LEAVES OBTAINED FROM THE SAME VINES.

1. *Proportions of water, ash, etc.*

Per centum - - - - - - - -	80·030
Dry matter - - - - - - - -	19·970
Ash - - - - - - - - -	4·260
Ash calculated from the dry matter - - -	21·282

2. *Analysis of the leaf* (slightly effervescent).

Silica - - - - - - - - -	33·950
Phosphates - - - - - - - -	13·825
Lime - - - - - - - - -	22·211
Magnesia - - - - - - - -	3·710
Potash - - - - - - - - -	13·378
Soda - - - - - - - - -	2·782
Chloride of potassium - - - - -	
Chloride of sodium - - - - -	4·874
Sulphuric acid - - - - - -	2·139
Carbonic acid - - - - - -	trace.
Organic matter - - - - - -	1·425
	98·294 S.

3. *Composition of the phosphates.*

PHOSPHATES - - - - - - -	13·825
Phosphate of peroxide of iron - - -	4·825
Lime - - - - - - - - -	3·991
Magnesia - - - - - - - -	0·075
Silicic acid - - - - - - - -	0·260
Phosphoric acid - - - - - -	4·674

It will be observed that the tomato vine differs in composition from that of the potato. The leaf of the tomato contains more silica, and no chloride of potassium.

This plant evidently requires a rich soil — a rich sandy loam. The varieties of it which may be produced by cultivation, are equally numerous with its congener the potato.

COMPOSITION OF THE LEAVES AND STEMS, CALCULATED WITHOUT ORGANIC MATTER.

	1. Stems.	2 Leaves.
Silica	5·152	35·05
Phosphates	14·410	14·27
Lime	8·890	22·94
Magnesia	0·163	3·82
Potash	49·660	13·81
Soda	0·770	2·87
Chloride of sodium	18·706	5·03
Sulphuric acid	0·366	2·20

By this comparison, the actual differences between the leaves and stems are more distinctly seen. The organic matter is of no consequence, so far as the ash is concerned. It is remarkable that the leaves contain so large a percentage of silica, and so little potash in comparison with the stem. An analogous fact exists with respect to the potato vine.

XXI. ORANGE CARROT.

As only a few analyses have been as yet made of carrots, beets and other root crops, I deem it expedient to place them in this connection, rather than devote to them a separate chapter.

The specimen analyzed was a large fine root eight or nine inches long, and one and a half or two inches thick at the large end. It was of a bright salmon-color, and perfectly sound. It was raised in the Hudson-river district, upon a sandy loam based upon the Albany clay. Analyses of this soil have been given in the first volume, p. 260.

1. *Analysis of* 20 grs.

		Per centum.
Silica	1·580	7·900
Phosphate of lime, iron and magnesia	3·800	19·000
Lime	0·010	0·050
Magnesia	trace.	trace.
Potash	7·659	38·295
Soda	1·467	7·335
Chlorine	0·370	1·850
Sulphuric acid	0·343	0·715
Carbonic acid	4·591	22·955
Organic matter	0·036	0·180
	19·856	98·380

2. *Calculated without carbonic acid and organic matter.*

Silex	10·415
Phosphates, etc.	25·051
Carbonate of lime	0·060
Magnesia	trace.
Potash	50·391
Soda	9·560
Chlorine	2·438
Sulphuric acid	2·261
	100·176

PROPORTIONS.

One hundred grains of the inside of the root, in a water bath at 212° Fahr., gave

Water	89·520
Dry matter	10·480
Ash	2·200
Calculated dry	20·992

The outside treated in the same way, gave

Water	83·78
Dry matter	16·22
Ash	2·63
Calculated dry	15·91

The carrot, of which the foregoing is an analysis, was preserved through the winter and part of the spring of 1848. Probably it had lost a portion of its water; and hence it would have furnished a larger percentage of dry matter and ash, had it been taken from the field.

3. *Analysis of the young Orange carrot.*

Silica	4·40
Phosphates	28·60
Carbonate of lime	5·40
Magnesia	9.58
Potash	27·54
Soda	15·28
Sulphuric acid	2·42
Chlorine	2·60
Carbonic acid	4·52
	100·34

From this single analysis, there appears more soda and less potash than in the old roo They were raised on different soils; and in order to establish the fact of material difference existing, it would require repeated analyses.

4. *Analysis of the young carrot leaves, belonging to the preceding specimen.*

Quantity taken 20 grs.

		Per centum.
Silica	1·900	9·500
Phosphates	3·710	18·550
Carbonate of lime	1·960	9·800
Magnesia	0·446	2·230
Potash	6·979	29·895
Chloride of potassium	1·359	6·795
Chloride of sodium	1·235	6·175
Sulphuric acid	1·750	8·750
Carbonic acid	2·101	10·505
	20·431	102·200

Proportions of water and ash in the young root and stems.

Root	100·00
Dry matter	10·48
Ash	0·94
Ash calculated dry	8·99

One plant, exclusive of root, weighing	252·3, gave
Dry matter	35·5
Ash	5·2
Per centum of ash in the whole top	2·06

From another specimen, I obtained from 100 grs.

Dry matter	14·00
Ash	1·30

The adherence of a small quantity of dirt may have aided in increasing the amount of dry matter, as well as of ash, though I am inclined to believe the last proportion nearer the truth than the first.

XXII. BLOOD BEET.

Soil a sandy loam, based upon the Albany clay.

1. *Analysis of* 18 grs.

	Quantity obtained.	Without carbonic acid. Per centum.
Silex	1·180	8·730
Phosphate	2·615	19·324
Carbonate of lime	0·140	1·042
Magnesia	0·576	4·146
Potash	6·325	46·684
Soda	1·343	9·928
Chlorine	0·304	2·245
Sulphuric acid	1·032	7·628
Soluble silica	0·012	0·061
Carbonic acid	4·307	
	17·834	99·788

PROPORTIONS.

100 grs. gave,	Water	86·42
	Dry matter	13·58
	Ash	1·10
	Calculated dry	8·10

The specimen furnishing the foregoing results had probably lost a portion of its water, having been kept through the winter, and exposed a day or two upon a fruit stand in market.

The herbage of one plant, weighing	648·5 grs. gave
Dry matter	47·6
Ash	8·5
In one week, the herbage increased to	3400 grs.
The root	408

Another beet and its top, three weeks afterwards, weighed:

Root	15840 grs.,	or 2 lbs. 1 oz.;
Top	7680 "	or 1 lb.;

the root having increased much faster than the top, during the time specified.

Those plants whose herbage is large, have large roots in the end.

2. *Analysis of the young beet.*

Diameter of the root, half an inch; length, 4 inches.

Silica	9·96
Phosphates	34·32
Carbonate of lime	7·96
Magnesia	2·88
Potash	11·74
Soda	1·16
Chlorine	4·00
Sulphuric acid	9·90
Carbonic acid	5·56
Soluble silica	1·60
Organic matter	8·82
	97·90

3. *Analysis of the young beet top.*

	Per centum.	Removed in a ton of dry tops.
Silica	10·550	236·32 lbs.
Phosphates	15·700	351·68
Carbonate of lime	6·550	146·72
Magnesia	2·900	64·96
Potash	30·435	682·08
Soda	6·475	144·48
Sulphuric acid	none.	
Chloride of sodium	9·195	206·08
Carbonic acid	12·190	273·28
	93·995	2105·60

A ruta baga obtained at the same time, and in the same state, gave the following proportions in 100 grs.

Water	86·51
Dry matter	13·49
Ash	1·25
Calculated dry	9·26

These proportions, for one trial, gave a greater amount of ash and dry matter in the ruta baga than in the beet, and less water.

XXIII. PARSNIP.

This analysis, it will be observed, is incomplete; but it shows that the parsnip is rich in phosphates.

1. *Analysis of* 12 *grains of the ash.*

	Quantity obtained.	Calculated without carbonic acid. Per centum.
Silica	1·600	13·705
Phosphates of lime, magnesia and iron	4·750	40·689
Carbonate of lime	0·010	0·085
Magnesia	0·080	0·680
Potash	3·744	31·560
Soda	1·478	12·666
Soluble silica	0·012	0·102
Carbonic acid	1·201	
	12·875	99·497

PROPORTIONS.

100 grs. gave,	Water	21·190
	Dry matter	78·810
	Ash	4·150
	Calculated dry	5·265

2. *Analysis of* 100 *grains of the ash.*

	Per centum.	Removed in a ton.	Removed from an acre.
Silica	12·800	286·72 lbs.	1720·32 lbs.
Phosphates	36·110	808·64	4851·84
Carbonate of lime	0·890	20·16	120·96
Magnesia	0·650	14·56	87·36
Potash	35·052	785·12	4710·72
Soda	12·954	290·08	1680·48
	98·516	2195·28	

An acre is estimated to yield at least six tons of parsnips.

RECAPITULATION AND GENERAL REMARKS ON THE FOREGOING ANALYSES.

1. It will be observed that the potato contains a large percentage of water, averaging seventy-one or two per centum. In this respect it exceeds the cereals, and hence is inferior to them in equal weights as a nutritious food. It contains, however, less water than the beet, carrot or turnip; and there is a closer resemblance in composition between the potato and the cereals, than between the latter and the other root crops. The potato, for instance, contains a large amount of starch, an element which renders it a highly important article for food. The potato furnishes, in the chlorides which are formed in the analyses, phosphates possessing the same characters as that found in the grains, a phosphate which is insoluble in water, and fusible at a low red heat. This is not found, however, where the phosphoric acid is obtained in combination with a base, as iron. It is not thrown down by ammonia, with phosphate of iron, lime and magnesia, and hence appears among the last results of analysis in the chloride. I have given it as insoluble matter in the chlorides. It contains a trace of silex and phosphate of lime, but consists of phosphate of potash and soda. The grains and the potato always furnish this product, in which respect they resemble each other; but the beet and carrot, though they may give a small amount of insoluble matter, yet it consists principally of soluble silica and organic matter.
2. The nitrogenous matters, in an equal weight of the potato and the cereals, are much less in the former; yet the latter give a greater amount upon the acre. This fact, it appears to me, decides the question as to the real value of the crop. The percentage of the nitrogenous or proteine bodies, as they are usually termed, appear small when compared with the other elements, or with those of the grains : they rarely amount to more than 1·50 or 2 per centum. The albumen and casein, which represent the proteine bodies, seem liable to some considerable variation by circumstances. They are liable, for example, to spontaneous changes in the course of the analysis; for, in some instances, very little albumen is obtained, and the whole product for proteine matter may be coagulated and thrown down by acetic acid. This result, however, does not alter or change the fact in regard to their existence in the potato. It will be observed, also, that there are differences in the amount of albumen and casein in different varieties. For cooking, and suiting the palate, it is not perhaps necessary that the kind of potato should be that which is richest in proteine compounds; but for feeding stock, it is a matter of more consequence. I doubt much, indeed, whether the use and value of the starch in this esculent is well understood; that it is merely intended for the support of respiration and animal heat, may well be doubted. These purposes, it is true, are important, and highly so; still, animals fatten rapidly upon potatoes. We may, I think, without danger of falling into a gross error, admit that the nutritive properties of the potato are not due alone to the proteine bodies.

3. The ash of the potato is small, and in this respect again it resembles the cereals. Another peculiarity consists in the large percentage of potash, and almost total absence of lime and magnesia; which shows a still further resemblance to the cereals. In a few instances, soda has exceeded in amount the potash; but as a general rule, the proportion of potash amounts nearly to one half of the whole inorganic matter.
4. I may once more refer the reader to the differences which exist between the parts of the potato, as exhibited in the analyses of the Mercer and Merino. The differences are not confined to the water, but extend also to the alkalies and phosphates. These differences meet perhaps with a partial explanation in the fact that the phosphates and alkalies are not so much in combination with the solid parts (fibre), as in solution in the juices. This appears from the fact that the fibre contains but a small proportion of phosphates and alkalies.
5. The fibre, however, must be regarded as a highly nutritive substance, and as well worthy of attention when the potato is used for starch. Indeed, animals which have been fed upon it exclusively, have thriven and grown fat; and hence as a matter of economy, establishments for the manufacture of starch from the potato ought to undertake the fatting of stock with the fibre, which is now too often regarded as an entirely worthless article.
6. I have made but partial examination of the condition of the diseased potato. It has been found, however, to contain more water, and less starch, than the sound tuber. When placed in a posture favorable for the purpose, it dries rapidly.
7. A comparison of the relative composition of the tops of potatoes is given in the analysis of the Early Shaw. In the tops, lime, magnesia and potash in the form of carbonates, exist in their ash; though as carbonates, they are merely the products of combustion, being derived from organic acids, which, during ignition, are converted into carbonates. The leaves and stem, when compared, present remarkable differences. The leaves, for example, give a much larger per centum of ash. In the leaf I find a large per centum of silex; in the stem, much less. The leaf too is rich in phosphates, particularly phosphates of iron and lime. In the stem, the phosphate of iron is but little more than a sixth part. While a magnesian phosphate abounds in the tuber, as in grains, it forms only a trifling element in the stem and leaves.

   There is an apparent anomaly in the proportion of water and ash in different parts of the stem. Thus the percentage of ash seems to diminish from the root upwards, while the water increases; but in the leaves, the solid residue and ash is much greater than in the bottom of the vine. In the stalks of ripe grain, the butt or base of the straw contains less ash than the top. It will be seen that the alkalies prevail in the stem of the potato, and the phosphates in the leaves. Soda, however, which is always present in the tuber, is only found in traces in the stem and leaves.
8. It can scarcely escape the observation of an attentive reader, that potato tops must form an excellent manure. They contain all the elements essential to the cereals; and hence it is that where the tops are left upon the soil to decay, the land does not im-

mediately appear exhausted. Still it is evident that the removal of so much potash in a crop, must, after a few years, render the land less productive. The ash, it is true, exists as a small percentage, but a large quantity is removed in a ton of tubers.

9. The composition of the tubers and tops indicates the kind of manure potatoes require. Ashes, inasmuch as they contain much potash and lime, are particularly useful. The value of salt as a manure is not yet determined, and yet it seems highly probable that it ranks high as a fertilizer for this crop. Gypsum also is another manure which is required : at least from the constant presence of sulphuric acid, it is evident that some compound containing it is required. The same may be said of the phosphates, as bones, or bones dissolved in sulphuric acid. Some salt of iron will be found highly useful; or the application of cinders and refuse from the smith's forge, and from iron foundries. Very few soils, however, are met with, which are deficient in iron; but this does not render the use of these substances nugatory.

10. Some botanists regard the tuber as a subterranean stem; but this can not be regarded as an established position, inasmuch as the tuber is wanting in the principal characteristics of a stem. Its growth and structure are much more like those of a fruit, the apple for instance; and hence the propriety of the French name *pomme de terre*.

11. It is a subject which has often called for remark, that a better crop of potatoes is raised from cut or sliced tubers, than from those which are planted entire. Different opinions prevail on this subject, in different parts of the State. There is, however, a fact connected with this question, which is important; it is the difference in the time at which the ends send forth shoots. The rose end, for example, begins to grow a week or more before the heel end. This appears to have a practical bearing : the separation of the tuber in the middle, and planting each end by itself, would seem to be the proper method to be pursued. We may obtain from the rose end an earlier crop than from the heel end; and it is probable that the difference in the time of sprouting, is connected with the greater amount of water contained in the former. This view of the question seems to be supported by the fact that diseased potatoes send forth shoots preternaturally, or at least before they appear upon sound ones. It will be remembered that I have already stated that diseased tubers contain more water than sound ones, as a general rule.

12. The carrot, which is regarded by farmers as a valuable root, especially for feeding stock, must be placed among the exhausting crops. Fifteen tons have been obtained from an acre. But the course which has been recommended and adopted, viz. that of sowing it with flax, is still more ruinous; for, in this mode of culture, two exhausting crops are cultivated together.

13. The parsnip gives a larger per centum of ash than the carrot; and admitting an equal crop, the soil is more exhausted. It is not, however, an objection to a crop that it is exhausting; for in most cases its value will be in proportion to its exhaustion. The great desideratum is to keep the soil in a productive condition. This end can be secured only by a knowledge of the influence of crops on the soil.

CHAPTER III.

OF THE FOOD OF CATTLE.

GRASSES, CLOVER, AND OTHER VEGETABLE MATTER USUALLY CALLED FODDER, etc.

THE food of cattle, of which I design to treat in this chapter, will be mostly limited to the grasses. This class of plants contains numerous species which are occasionally eaten; still the number on which cattle depend for support, is quite limited. They constitute a natural family of plants, possessing many characteristics in common. These are not confined to external appearance, but extend to their chemical constitution. In this latter point of view, the most remarkable character which they possess in common, is their silicious skeleton. Other plants which have been under consideration, were, properly speaking, *lime plants*, or lime united with an organic or phosphoric acid, or both. In the case of grasses, however, silica combined with an alkali constitutes the greatest part of their frame work, which is a hollow, light, fluted cylinder, possessing great strength for the amount of material which it contains. This is a necessary constitution, inasmuch as with almost any other they would possess stems too weak to brave the winds and storms. A sufficiency of silica, then, is the great requisite to their maturity; in which state only seed can be perfected, and their species propagated. They are, however, nutritious in their immature state, and are freely eaten in all stages of growth; but this fact should not lead us to adopt the opinion that they are equally nutritious at all stages of growth. They fulfil an important purpose, as a tender juicy food, in the early spring; but they soon reach a point where they are in the greatest perfection, after which they lose daily their best parts by transmission to the seed; while the stem becomes dry and ligneous, and is very poorly adapted even to sustenance, much less to improvement and progress.

For agriculturists, it is an important matter to ascertain when grasses are in their best condition for the food of stock. In determining this question, we may be guided by the nature of the case. It is evident that when a grass has put forth its blossoms, it has reached its natural size, its height and diameter; it ceases to grow : the energies of the plant are no longer directed to this end. Now another important function is to be fufilled : the perfection of seed. In order to fulfil this function, the nutritious matter in the stalk begins to concentrate in the embryo of the seed, or seed vessel; and in consequence of this, the stalk at least loses more than it gains; and after a short period, during which slow changes

take place, the stalk dries and becomes woody, hard, and less suitable both for mastication and nourishment. We arrive at the same results, the period of maturity, by analysis; for example, it is found that the nutrient matter does not increase in the stem of the grass after its blossoms are matured. These remarks of course apply only to those cases where the stalk, and not the seed, is to be used as food.

A character of the grasses, which is worthy of notice, is their mode of growth so as to form a turf. This, however, is not universal. The coarse grasses, as the sedges, form hummocks in marshes, but never a uniform surface. Rye, oats and wheat, never form turf. This property belongs to timothy, red-top, and several others of the better kinds of grasses. Besides giving to a landscape a superior beauty and elegance, an accumulation of nutriment is secured at the surface, which, when the turf is broken and turned over, is of the highest importance in the growth of many cultivated vegetables. It is a storehouse of nutriment, which may have been accumulating many years. This grassy surface again exerts an important influence upon the temperature, maintaining a more uniform state and condition, and preventing wide fluctuations. So we ought to remember that turf contributes largely to the stability of the earth's surface: rains and currents cease comparatively to wash and abrade or furrow the ground, and convenience is thereby secured; for what can a farmer do with a surface deeply channelled?

If we take a right view of the subject, we shall not probably form too high an estimate of the functions which the grasses perform in the economy of nature. We generally think of them as fodder for cattle, and in this light they are of the utmost importance; but we have seen that this is only a small item in the good they do, and in the services they perform. Though humble in their appearance and pretensions, they serve man's purpose in the turf, in the temperature, and in the stability and permanence of the earth's surface. To be impressed deeply with these facts, we have only to witness the moving sands of the seashore, or of a desert.

Grasses, when frequently cut or mown, become by the operation much finer than natural in their texture: it is in this way that a smooth velvety lawn is formed, which possesses so much beauty in parks. This fine grass, however, is not a very valuable fodder: it is fit only for the smaller and more tender herbivora, as lambs, calves, etc.

Grasses, though really as important as represented, are probably not the most profitable source of food for cattle. Many productions exceed the value of hay as fodder. Roots and grain, even though cultivated at an expense far greater than that which attends the cultivation and growth of timothy or red-top, still outrank them in profit and value. Still there is no substitute, in the long run, for grass and pasturage in the present arrangements: they will always form an important means of supporting our herds of cattle.

The valuable grasses belong to several genera, in each of which there are several species. Among the most important is the *Phleum*, of which there are two species in New-York; one of which, the *pratensis*, is the common timothy grass, known in New-England under the name of *foxtail*.

The common timothy may be regarded as the standard grass for all the States north of Virginia and Tennessee. South of these States, the temperature and dryness are not favorable to its cultivation. Even in the Northern States, it often suffers from drouth; or it seems to be more impatient of this state of the weather, than any of the other grasses. The drouth, or dry atmosphere, upon timothy, is often well marked after mowing it; when, if rains do not soon succeed, the sod becomes dry and parched, and the surface of the ground cracks. So a dry spring, especially if the field is fed, is seriously injurious to the future crop for the same cause. Timothy must first cover the ground, that its herbage may protect its roots; and then the farmer may be secure, the entire season, of a fine crop of this grass. It will continue to grow until late in autumn.

Timothy is regarded as a great exhauster of the soil, and on this account it is objected to, but without sufficient consideration; for this reason, it is the more valuable food, furnishing in itself an amount of nutriment equal to its exhausting powers. This view may be true only where the farmer consumes the product on his farm, and is in a condition to restore a large proportion of the consumed fodder to his meadows.

The soil most congenial to timothy, is one well charged with a light black mould and occupying a rather low position, as in the vicinity of river bottoms. The mould, from its absorbent and retentive powers, secures for the season an amount of moisture sufficient for the uses of the plant.

There are two other kinds of grass which resemble the timothy, viz. *Alopecurus pratensis* (Meadow foxtail grass), and *A. geniculatus*. The former is regarded as superior to timothy: it does not, however, attain maturity from the seed under four years, and hence is not well suited to a system of alternate husbandry. The latter is a native grass, and is more abundant in moist or wet places. It is smaller than the *Phleum*, and is bent at the joints.

Another kind is the *Dactylis glomerata* (Orchard grass), the flower heads being clustered into several smaller heads. It is an introduced grass, and is well adapted to be sown with clover, as it comes to maturity at the same time. It is better for pastures than meadows, and requires close grazing. It grows rapidly, and, perhaps for this reason, forms a delicate herbage for sheep.

An earlier kind of grass than timothy, is the Spear grass, Meadow grass, or Kentucky blue grass: botanically it is the *Poa pratensis*. It is a native of Europe, but is extensively cultivated in this country. It is perennial, and grows well in all parts of the Union, at least as far south as Charleston, S. Carolina. One of the merits of this grass consists in its being in a condition for use during a great part of the year. It is an early grass, but continues also to quite a late period in the autumn. It furnishes but one flower stalk, which, when matured, is succeeded by fine long blades or leaves.

The genus *Poa* furnishes also many other species worthy of notice. The *P. trivialis* (Rough meadow grass) resembles the former: it is not as early, but its yield is equally great, and its quality not inferior.

In addition to these, Mr. BUCKLEY has described, in the American Journal of Science and Agriculture, about twenty kinds or species belonging to the genus *Poa*.

Manna grass, *Glyceria fluitans*. This grass is remarkable for its sweetish seeds. It grows from four to six feet high in wet places. As cattle are very fond of it, it may be profitable to cultivate it in those places where it is permanently wet and otherwise unproductive. Water fowls are all exceeding fond of the seeds; and hence the margins of ponds and streams may be very profitably stocked with it. Even fish are fond of the seed.

In addition to this very brief notice of the grasses, I may allude in passing to the family of *Clovers*, which, though not botanically grasses, are still important to cattle in many instances, and often occupy the place of grasses. The red and white clover seem to be distributed generally, and indeed as much so as any of the grasses proper. Their seeds spring up in every new field, and upon old fields under favorable circumstances, especially where gypsum has been strewed.

The habits of the two kinds of clover are different: the red has an upright, and somewhat robust stem; the white, a small wiry creeping stem, which becomes a pernicious weed in a garden, very difficult to eradicate, inasmuch as the remains of part of a stem with its root is sure to live and extend itself. It exhausts the soil, after a few years, of the peculiar elements which it requires, and gradually disappears from the fields. In new pastures it is thick and abundant, and fills the air with its perfume; but in the, old it has given place to the less nutritive but more hardy grasses.

The clovers, as is well known, furnish important means for increasing the fertility of soils. They improve the soils by their large and spreading roots. They also penetrate deeply, and bring up the phosphates and other fertilizing matters to the surface. They can not increase the mineral or inorganic matters, but they increase the organic.

According to BOUSSINGAULT, one acre will produce 12¾ cwt. of perfectly dry clover roots, which is a large amount of useful matter in whatever light it is regarded; either as a production affecting the soil mechanically, or as one which acts chemically, first, in abstracting the deeper nutritive materials, and afterwards leaving them diffused in the soil as food for other more valuable plants for man. This is not to be regarded as new matter added to the soil, but as matter transferred through the agency of this plant from points inaccessible to others, and hence becoming available by a slight expense to the farmer. It is this view of the subject which makes the clover crop so valuable in a specific rotation, by furnishing an immense amount of nutritive matter to the wheat crop, which is in the most favorable condition to promote its growth and perfection.

Lucerne yields a much larger amount of roots, which, after the crop has remained a few years, are cut up with the turf and burned. This crop is well adapted to sandy soils of the Hudson river valley, and might, it is believed, profitably receive the farmer's attention. It is not, however, adapted to the use of milch cows, as it imparts an unpleasant taste to the milk and butter; but it is wholesome and nutritive to most kinds of stock.

Although the grasses and clover are spoken of as the food of cattle, either of which may be employed indiscriminately for the other, still it will be shown that they differ

materially in composition. Grasses are strictly silica plants; but the clovers, in place of silica, contain lime and magnesia. The other nutritive bodies, however, are not very dissimilar, consisting as they do in each class of albumen in conjunction with woody fibre, and phosphates of lime, magnesia and iron.

As in the potato, so in the grasses, it is essential that we should ascertain the proximate elements of which they are composed. I have been able as yet to make but a few analyses of these products, scarcely sufficient, it is supposed, to aid in estimating their practical use in feeding and fattening stock to the greatest advantage. Regarding the inorganic and organic parts as of equal importance, the work of analysis is but half completed when it stops with the ash. As my attention has been mostly directed to the ash analysis, I shall first give my results in this research; designing, if necessary, to select from the works of others such analyses of the organic parts as shall be deemed sufficient to answer the inquiries of agriculturists, or so much as I deem necessary to an entire view of the subject, or to a somewhat complete exhibition of the composition of these plants.

I. TIMOTHY GRASS (*Phleum pratensis*)*.

1. *First specimen : collected May* 20, 1848.

Stalk 24 inches long; head not visible.

	PROPORTIONS.
Stalk	65·30
Leaf	34·70
	100·00

Water in the stalk	81·00
Dry matter	17·80
Ash	1·20
Ash calculated dry	6·74
Water in the leaf	75·00
Dry matter	23·00
Ash	2·00
Ash calculated dry	8·69
Water in the whole plant	78·00
Dry matter	20·46
Ash	1·60
Ash calculated dry	7·82

* By Mr. BALL, Hoosic Falls, Rensselaer county.

2. *Second specimen : gathered June* 30, 1848.

Whole height 40 inches; head 5 inches long, in full blossom.

	PROPORTIONS.
Stalk - - - - - -	52·03
Leaf - - - - - -	27·64
Head - - - - - -	19·73
	100·00

Water in the stalk - - - - - -	74·75
Dry matter - - - - - - -	23·75
Ash - - - - - - - -	1·50
Ash calculated dry - - - - - -	6·31
Water in the leaf - - - - - -	71·07
Dry matter - - - - - - -	26·56
Ash - - - - - - - -	2·37
Ash calculated dry - - - - - -	8·92
Water in the head - - - - - -	66·25
Dry matter - - - - - - -	32·30
Ash - - - - - - - -	1·45
Ash calculated dry - - - - - -	4·45
Water in the whole plant - - - -	70·69
Dry matter - - - - - - -	27·54
Ash - - - - - - - -	1·77
Ash calculated dry - - - - - -	6·42

3. *Ash of timothy grass.*

This specimen was made into hay, and was very bright and thoroughly sun-dried. Length 3 feet and 8 inches; head 7 inches, and cut before its blossoms were mature. 100 grains of the thoroughly sun-dried hay lost in the water bath, 10·30; ash, 3·00. Of carbonic acid, only a trace was found in the ash.

		Per centum.
Quantity employed - - - - -	20·000 grs.	
Silica - - - - - - -	8·330	41·650
Phosphates - - - - - - -	3·385	16·925
Carbonate of lime - - - - -	9·040	0·200
Magnesia - - - - - - -	0·100	0·500
Potash - - - - - - -	6·152	30·760
Soda - - - - - - - -	0·204	1·020
Soluble silica - - - - - -	0·040	0·200
Chloride of sodium - - - - -	0·498	2·490
Sulphuric acid - - - - - -	0·826	4·130
	19·535	97·875

COMPOSITION OF THE PHOSPHATES.

PHOSPHATES - - - - - - -	3·385
Phosphate of peroxide of iron - - -	0·400
Lime - - - - - - - -	1·700
Magnesia - - - - - - -	0·490
Phosphoric acid - - - - - -	1·537

The ash contained six per centum of organic matter, which is not noted in the work.

From the foregoing analyses, there will be removed from the soil, in timothy hay, the following amounts of the elements which the ash is found to have contained :

	In one ton.	From an acre.
Silica . - - - - - - -	26·292 lbs.	65·730 lbs.
Phosphates - - - - - -	10·155	35·387
Carbonate of lime - - - - -	0·120	0·360
Magnesia - - - - - - -	0·300	0·900
Potash - - - - - - - -	18·456	46·160
Soda - - - - - - - -	0·612	1·530
Chloride of sodium - - - - -	1·492	3·730
Soluble silica - - - - - -	0·120	0·300
Sulphuric acid - - - - - -	2·476	6·190

II. MIXED HAY.

Fully ripe and bright : grown upon the clay loam of Albany county.

ANALYSIS.

Silica - - - - - - - -	53·950
Phosphates - - - - - - -	12·050
Carbonate of lime - - - - -	0·250
Magnesia - - - - - - -	0·045
Potash - - - - - - - -	13·955
Soda - - - - - - - -	5·635
Sulphuric acid - - - - - -	5·500
Chlorine - - - - - - -	1·315
Soluble silica - - - - - -	0·400
Organic matter - - - - - -	5·350
	98·450

The soil upon which this and several of the preceding substances grew, has been analyzed, and found to be composed as follows :

	I. Surface.	II. 8 inches below surface.
Silica	86·32	86·25
Water	3·25	2·00
Organic matter	4·25	2·18
Carbonate of lime	0·20	0·17
Peroxide of iron and alumina	3·66	8·53
Magnesia	0·13	0·11
Potash	0·19	0·08
Soda	0·37	0·05
Soluble silica	1·00	0·25
	99·37	99·62

In addition to the mixed grasses growing upon the soil of this lot, I may add the Early Shaw potato, beet, carrot, and tomato vines. I have under cultivation upon the same lot, several varieties of indian corn which have been already analyzed, and more in a state of preparation for this process. The soil is sandy to the depth of two or three inches, and is then succeeded by a yellowish stiffish clay, known as the *Albany clay*. This soil, or some combination of it with more sand or clay, is the predominant soil of the towns in the valley of the Hudson river. It is an excellent soil for many productions, retaining admirably the manures when properly mixed with it.

III. RED-TOP (*Agrostis vulgaris*).

Selected from dried hay.

ANALYSIS.

Silica	41·90
Phosphates	13·75
Potash	4·92
Chloride of sodium	2·00
Carbonate of lime	10·03
Magnesia	6·64
Soda	9·61
Organic matter	2·35
Sulphuric acid	7·30
	98·50

It appears from the foregoing analysis, that this is a valuable grass, containing less silica than the mixed grasses consisting of timothy, speargrass, red-top, some clovers, etc. The amount of magnesia is large, and the soda nearly twice as large as in the mixed grasses.

IV. QUACK-GRASS (*Triticum repens*).

1. *First specimen.* Grown in the rear of the Old State House: cut May 1; height 11 inches. Five whole plants weighed 124 grs., and gave the following percentages:

Water	79·355
Dry matter	20·645
Ash	2·528
Ash calculated dry	12·245
Organic matter calculated dry	87·755 S.

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2. *Second specimen.* From the same place: cut June 8; height 46 – 48 inches, just beginning to head out. Five stalks weighed 361 grs., and gave the following percentages:

Water	80·232
Dry matter	19·768
Ash	2·081
Ash calculated dry	10·527
Organic matter calculated dry	89·473 S.

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3. *Third specimen.* From the same place: cut June 21; height 50 inches, in flower. Two stalks weighed 174·20 grs., and gave the percentages following:

Water	71·618
Dry matter	28·382
Ash	2·612
Ash calculated dry	9·203
Organic matter calculated dry	90·797 S.

The above shows — excluding the water — a gradual decrease of inorganic, and a corresponding increase of organic matter as the plant advances in age.

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4. *Fourth specimen.* From the same place: cut May 1; height 11 inches. 100 grains of ash gave

	Per centum.
Carbonic acid	1·455
Silicic acid	27·150
Phosphates	17·250
Lime	0·112
Magnesia	trace.
Potash	7·350
Soda	26·785
Sodium	3·565
Chlorine	5·425
Sulphuric acid	4·811
Organic acids	5·200
	99·103 S.

The above analysis was made under more favorable circumstances, and with a better ash, and hence is more deserving of credit than the following : it is, however, in an earlier stage of growth, and would necessarily differ from the first analysis.

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5. *Analysis of the ash of* Triticum repens, *just previous to the appearance of the flower-spike or head.*

	Per centum.
Silica	40·500
Coal	9·300
Phosphates	15·300
Lime	0·959
Magnesia	none.
Potash	24·417
Soda	1·433
Chloride of sodium	3·706
Sulphuric acid	
Carbonic acid	trace.
Organic matter	2·400
	98·015

COMPOSITION OF THE PHOSPHATES.

Phosphates	15·300
Phosphate of peroxide of iron	1·300
Lime	3·272
Magnesia	2·600
Silicic acid	trace.
Phosphoric acid	8·128

PROPORTIONS.

100 grs. of the green plant gave

Water	75·39
Dry matter	24·61
Ash	2·52
Ash calculated dry	10·24

V. SPEAR-GRASS (*Poa pratensis*).

1. *First specimen.* Grown in the rear of the State House : cut May 13, large growth 16 inches high, just heading out. Eight stalks weighed 98·12 grs., and gave

	Per centum.
Water	81·564
Dry matter	18·436
Ash	2·267
Ash calculated dry	12·296
Organic matter calculated dry	87·704 S.

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2. *Second specimen.* From the same place : cut June 8; height 30 inches, in flower. Eight whole stalks, with radical leaves, weighed 210·25 grs., and gave

	Per centum.
Water	77·374
Dry matter	22·626
Ash	2·073
Ash calculated dry	9·162
Organic matter calculated dry	90·838 S.

This plant also shows the same comparative decrease of inorganic, and corresponding increase of organic matter as it advances in age, as the *Triticum repens.*

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3. *Third specimen.* From Hoosic-falls, Rensselaer county : gathered May 20, 1848; whole height 22 inches.

	PROPORTIONS.
Stalk	43·00
Leaf	57·00
Water in the stalk	80·75
Dry matter	17·91
Ash	1·34
Ash calculated dry	7·48
Water in the leaf	75·50
Dry matter	21·56
Ash	2·84
Ash calculated dry	13·17
Water in the whole plant	78·12
Dry matter	13·79
Ash	2·09
Ash calculated dry	10·05

4. *Fourth specimen.* From the last mentioned locality : gathered June 15, 1848; stalk 32 inches, in full blossom.

	PROPORTIONS.
Stalk	71·00
Leaf	6·45
Blossom	22·55
	100·00

Water in the stalk	68·50
Dry matter	30·50
Ash	1·00
Ash calculated dry	3·28
Water in the leaf	66·00
Dry matter	31·90
Ash	2·10
Ash calculated dry	6·58
Water in the blossom	58·00
Dry matter	39·97
Ash	2·03
Ash calculated dry	5·08
Water in the whole plant	64·17
Dry matter	34·12
Ash	1·71
Ash calculated dry	5·01

5. *Analysis of the ash, selected from well made hay.*

	Per centum.
Silica	56·320
Phosphates	14·980
Carbonate of lime	3·540
Potash	15·624
Soda	6·828
Magnesia	1·996
Sulphuric acid	0·200
Chlorine	0·863
	100·351

It is highly probable that this grass had passed its mature state, and that its stem had become drier and more ligneous than when in blossom, and hence the per centum of silica is large when compared with that of the Red-top. This grass, in consequence of its early maturity, becomes dry and hard when left standing till timothy is ripened.

The following analysis of the ash of the plant in an earlier state, represents probably its true composition when mature.

6. *Spear grass* : cut May 13; height 16 inches, flower spikes just appearing. 100 grains of ash gave

	Per centum
Silicic acid	48·300
Phosphates	11·650
Lime	0·030
Magnesia	trace.
Potash	3·531
Soda	12·505
Sodium	4·180
Chlorine	6·365
Sulphuric acid	5·156
Organic acids	4·400
Carbonic acid not determined.	
	96·186 S.

VI. ROUGHISH MEADOW-GRASS (*Poa trivialis*).

Grown in the rear of the State House : cut June 21; height 40 inches, in flower. Two spears weighed 61·40 grs., and gave

	Per centum.
Water	61·407
Dry matter	38·593
Ash	3·071
Ash calculated dry	5·002
Organic matter calculated dry	94·998 S.

Burns hard; ash slightly alkaline.

VII. SWEET FESCUE-GRASS (*Glyceria fluitans*).

1. *First specimen.* Grew three miles south of Albany, in a swamp : cut June 22; height 40 – 48 inches, in flower (aquatic). One stalk weighed 123·25 grs., and gave

	Per centum.
Water	58·369
Dry matter	41·631
Ash	2·198
Ash calculated dry	5·279
Organic matter calculated dry	94·721 S.

Ash saline.

2. *Second specimen.* Taken from a swamp three miles south of Albany : plant in flower. Ash of a reddish tint, and slightly effervescent. 100 grs. gave as follows :

	Per centum.
Silicic acid	35·250
Phosphates	19·350
Lime	0·055
Magnesia	0·025
Potash	9·130
Soda	19·840
Sodium	1·605
Chlorine	2·445
Sulphuric acid	8·910
Organic acid	2·450
Carbonic acid not determined.	
	98·060

VIII. BULRUSH (*Juncus effusus*).

Gathered in a swamp three miles south of Albany : cut June 22; height 40 – 43 inches, just out of flower. One stalk weighed 46 grs.

	Per centum.	
Water	46·586	
Dry matter	53·414	
Ash	0·978	
Ash calculated dry	1·831	
Organic matter calculated dry	98·169	S.

Ash saline. The proportion of inorganic matter in this plant is very small.

IX. SLENDER CLUBRUSH (*Scirpus tenuis*).

Gathered in a swamp three miles south of Albany : cut June 22, in flower.

	Per centum.	
Water	38·241	
Dry matter	61·759	
Ash	2·663	
Ash calculated dry	4·312	
Organic matter calculated dry	95·688	S.

Ash saline.

Analysis of the ash.

	Per centum.
Silex	27·000
Phosphates of lime, iron and magnesia	16·800
Carbonate of lime	5·450
Magnesia	0·100
Potash	1·610
Soda	24·120
Chlorine	3·360
Soluble silica	1·000
Sulphuric acid	11·880
Carbonic acid	0·710
Organic matter	5·260
	97·290

In this analysis, we find large amounts of soda and sulphuric acid, and only a small quantity of potash. It is an unimportant grass, and it is not sought after by any kind of stock, though it is occasionally eaten. If it can be obtained, however, for the litter of the barn yard, or for the compost heap, it would form a valuable addition.

X. BLACKISH-GREEN CLUBRUSH (*Scirpus atrovirens*).

Gathered three miles south of Albany: cut June 22; height 30–36 inches, just out of flower. One stalk weighed 112·62 grs., and gave

	Per centum.
Water	40·881
Dry matter	59·119
Ash	2·353
Ash calculated dry	3·980
Organic matter calculated dry	96·020

Ash saline. The percentage of inorganic matter in these two last species of *Scirpus* is greater than in the *Juncus effusus*, and less than in the *Glyceria fluitans*, and the other grasses given.

XI. The CARICES form another family of coarse grasses, in which the species are very numerous. I subjoin a single analysis of a *Carex*, a coarsish swamp grass, cut before the spikes had appeared.

	Per centum.
Silex	51·250
Phosphates of lime and iron	2·600
Chlorine	0·560
Carbonate of lime	3·500
Magnesia	0·400
Potash	26·060
Soda	4·065
Sulphuric acid	3·755
Carbonic acid	6·170
	98·190

XII. PANICUM CRUS-GALLI (*Cocksfoot grass*).

Grown in the yard of the Old State House : height about 3 feet, in flower. 100 grs. of the plant, nearly dry, gave

	Per centum.
Water	4·737
Dry matter	95·263
Ash	11·479
Ash calculated dry	12·049

100 grs. of ash gave the following results :

		Per centum.	Elements removed in one ton of dry hay.
Silicic acid		17·325	45·777 lbs.
Coal		1·850	4·995
Phosphates :			
Phosphate of iron	0·325		
Lime	0·625		
Magnesia	2·831		
Silicic acid	0·625		
Phosphoric acid	6·894		
		11·300	30·510
Lime		3·060	8·262
Magnesia		2·618	7·068
Potash		36·656	98·971
Soda		1·885	5·089
Chloride of sodium		5·723	15·452
Sulphuric acid		8·524 S.	23·015

Carbonic acid and organic matter not obtained.

OF THE DIFFERENT VARIETIES OF CLOVER, THEIR COMPOSITION, AND PROPORTIONS OF THEIR ELEMENTS.

XIII. LARGE RED CLOVER (*Trifolium pratense*).

Gathered in the yard of the State House : cut May 12; height 15 inches, 5 and 6 leaves above ground. Four stalks weighed 234·625 grs., and gave

	Per centum.
Water	86·136
Dry matter	13·864
Ash	1·381
Ash calculated dry	9·961
Organic matter calculated dry	90·039 S.

The upper half of the root (two years old) of the above clover plant, with the cuticle taken off to free it of adhering soil, gave

	Per centum.
Water	81·060
Dry matter	18·940
Ash	1·529
Ash calculated dry	8·073
Organic matter calculated dry	91·937 S.

The lower half of the same root gave

	Per centum.
Water	81·298
Dry matter	18·702
Ash	1·365
Ash calculated dry	7·298
Organic matter calculated dry	92·702 S.

In this specimen of clover, the percentage of inorganic matter, calculated dry, is greater in the stalk and leaves than in the root, and less in the lower half of the root than in the upper.

XIV. RED CLOVER*.

1. *First specimen.* Gathered May 20, 1848 : whole height 9 inches ; buds just beginning to form.

	PROPORTIONS.
Stalk	63·75
Leaf	36·25
	100·00

* Determined by Mr. BALL, Hoosic-falls, Rensselaer county.

Water in the stalk	88·30
Dry matter	10·95
Ash	0·75
Ash calculated dry	6·85

Inorganic matter in a ton, 153·44 lbs.

Water in the leaf	78·00
Dry matter	20·00
Ash	2·00
Ash calculated dry	10·00

Inorganic matter in a ton, 224 lbs.

Water in the leaf and stalk	84·15
Dry matter	14·48
Ash	1·37
Ash calculated dry	9·46

Inorganic matter in a ton, 211·68 lbs.

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2. *Second specimen.* Gathered June 10 : whole height 24 inches, in full blossom.

PROPORTIONS.	
Stalk	58·12
Leaf	22·12
Blossom	19·76
	100·00

Water in the stalk	80·88
Dry matter	18·06
Ash	1·06
Ash calculated dry	5·87

Inorganic matter in a ton, 131·04 lbs.

Water in the leaf	73·56
Dry matter	23·56
Ash	2·88
Ash calculated dry	12·22

Inorganic matter in a ton, 273·72 lbs.

Water in the blossom	79·06
Dry matter	19·57
Ash	1·37
Ash calculated dry	7·00

Water in the whole plant	77·83
Dry matter	20·40
Ash	1·77
Ash calculaled dry	8·67

Inorganic matter in a ton, 193·76 lbs.

3. *Third specimen.* Gathered July 15, 1848 : stalk 24 inches long, fully ripe.

	PROPORTIONS.
Stalk - - - - - -	60·96
Leaf - - - - - -	14·94
Head - - - - - -	24·10
	100·00

Water in the stalk - - - - - -	25·19
Dry matter - - - - - - -	70·78
Ash - - - - - - - -	4·03
Ash calculated dry - - - - - -	5·69
Inorganic matter in a ton, 127·68 lbs.	
Water in the leaf - - - - - -	33·77
Dry matter - - - - - - -	57·36
Ash - - - - - - - -	8·87
Ash calculated dry - - - - - -	15·48
Inorganic matter in a ton, 346·08 lbs.	
Water in the head - - - - - -	13·00
Dry matter - - - - - - -	81·37
Ash - - - - - - - -	5·63
Water in the whole plant - - - -	23·99
Dry matter - - - - - - -	69·83
Ash - - - - - - - -	6·18
Ash calculated dry - - - - - -	8·85
Inorganic matter in a ton, 198·24 lbs.	

XV. WHITE CLOVER*.

Gathered at Hocsic-falls, July 1, 1848 : whole height 9 inches, in full blossom, second growth this season.

Water in the whole plant - - - -	81·50
Dry matter - - - - - - -	16·75
Ash - - - - - - - -	1·75
Ash calculated dry - - - - - -	10·44
Inorganic matter in a ton, 234·08 lbs.	

* By Mr. BALL.

Analysis of the ash.

	Per centum.
Silica	28·075
Phosphate of lime, magnesia and iron	19·325
Carbonate of lime	16·730
Magnesia	2·175
Potash	10·880
Soda	15·640
Sulphuric acid	2·305
Chlorine	0·615
Carbonic acid	4·234
	99·979

The white clover differs, as will be observed, from the red, in containing much more silica. This, however, is the only analysis which has been made; and it may appear, on a reëxamination, that it is too high.

The cultivation of red clover is regarded by the farmers of New-York as one of the important means for increasing the immediate fertility of the soil. Its cultivation forms a part of a system of rotation of crops, in which the decaying clover plant in the soil constitutes the manure for the coming crop. As a part of a plan of cropping, it is cheap and useful. Its value is supported by an analysis of its inorganic part, which is well worthy an attentive consideration. The following are all the analyses which I am able to present: the first is of clover in its young state, before the development of its blosoms.

XVI. YOUNG CLOVER.

PROPORTIONS.

1. *Young clover, growing upon a lot one mile southwest of the State House.*

Water	80·31
Dry matter	19·69
Ash	0·40
Ash calculated dry	2·03

2. *White clover, growing upon the same lot.*

Water	90·49
Dry matter	9·51
Ash	0·85
Ash calculated dry	8·94

3. *Analysis of the ash of young clover.*

	Per centum.	Removed in a ton of hay.
Silica	0·981	0·446 lbs.
Phosphates	30·245	13·459
Carbonate of lime	7·642	4·400
Magnesia	2·285	1·015
Potash	33·688	14·991
Soda	7·164	3·147
Chlorine	3·642	1·620
Sulphuric acid	6·723	2·991
Carbonic acid	5·744	2·556
	98·114	44·625

XVII. CLOVER HAY (Cut when ripe).

100 grs. of the sun-dried clover lost in the water bath	12·73
And gave ash	5·56

1. *Analysis of the stems and leaves, or the whole plant.*

	Per centum.	Removed in a ton.
Silica	0·850	1·054 lbs.
Phosphates	20·600	25·544
Carbonate of lime	30·950	38·378
Magnesia	3·930	4·873
Potash	25·930	32·153
Soda	14·915	18·394
Chlorine	1·845	2·288
Sulphuric acid	0·495	0·624
	99·515	123·308

2. *Analysis of the upper part of the stem, with the superior leaves and heads.*

	Per centum.	Removed in a ton.
Silica	0·810	1·003 lbs.
Phosphates	21·900	27·156
Carbonate of lime	32·333	39·969
Magnesia	0·200	2.480
Potash	27·940	34·645
Soda	6·753	8·374
Chlorine	3·780	4·533
Sulphuric acid	3·366	4·174
	98·682	122·364

The two preceding analyses were of the ash as formed from well dried hay, quite ripe, which grew in Bethlehem, the soil of which is often sandy upon a basis of Albany clay. It is less rich than the soil of the State House lot; hence the large amount of phosphates and potash in the ash of the young clover.

XVIII. SWEET-SCENTED CLOVER, *var.* ALBA (*Mellilotus officinalis*).

Introduced and cultivated in gardens, but grows spontaneously in rich ground about Albany.

Composition of the upper part of the plant.

	Per centum.
Silica	5·600
Phosphates	33·050
Carbonate of lime	28·000
Magnesia	6·040
Potash	20·305
Soda	2·625
Sulphuric acid	4·125
Chlorine	1·355
	101·100

One hundred grains of the sun-dried plant lost in the water bath 6·22 grains, and gave ash 2·58.

RECAPITULATION AND REMARKS.

1. In view of the effects of the hay crop on soils, it is evident that there are three substances which are removed in large quantities, viz: silica in a soluble condition; phosphoric acid in combination with iron, lime and magnesia; and potash in combination with silicic acid. Lime is not found in quantities so large as potash. It is to be noted, however, that grasses differ in composition. In the red-top, a favorite grass, there is ten per centum of carbonate of lime. In the *Triticum repens*, which grows luxuriously in the yard of the Old State House, where there is no deficiency of lime in the soil, the lime amounts to only 0·96 per centum, and the potash to 24. Soda occasionally forms a large percentage; and from the facts, it would seem probable that the plants take up soda or potash indifferently.
2. Of the grasses, timothy and red-top seem to have a composition well adapted to the wants of animals which feed upon hay. The proportion of silica in timothy is less than 45 per centum; and the phosphates amount to 16 or nearly 17 per centum. The carbonate of lime is 0·2 per centum; while the potash amounts to 30 per centum, or ⅓ of the whole ash.
3. It will be observed that the amount of water in the stem and leaf differ, being less in the leaf and head than in the stem; consequently the amount of nutriment is pro-

portionally greater in the leaf and head, than in the stem. There is less than one-third of dry matter in the stalk. Hay, in making or drying in the sun, loses more than one-half its weight in water. Sun-dried hay loses about 12 per centum, when exposed to 212° in a water bath. It does not differ materially in this respect from the straw of grains.

4. In a ton of dry hay, about 150 lbs. of silica, phosphates and potash, are removed from the soil. So if two tons are yielded per acre, 300 lbs. of these important substances are taken off. From this fact, it is evident that but few soils can produce an abundant harvest, unless the removed matter is returned in some form.
5. For a crop of hay, it is well determined what manures are required. In treating a field for grass, however, we may furnish manures indirectly; that is, apply those matters which will unlock the potash from its combination with silica. This is often effected by the use of hydrate of lime. Immediate results follow from the application of ashes, leached or unleached.
6. Sulphur is another element which is always present in hay : it may be in combination with lime or other alkaline earths, or in its simple state in the albuminous matters.
7. An interesting fact is brought out by the examination of the constituents of grasses at different periods; thus in the *Triticum repens*, the inorganic matter decreases with the age, while the organic matter increases.

   The coarse grasses of swamps, and those usually known as aquatics, contain large quantities of water, while the inorganic part or ash is quite small. They do not seem to be valuable for cattle, and but few are eaten. Some, however, which are early, are sought after; and then again some of the later grasses of a coarse texture are eaten, as the cocksfoot grass, which continues green till frost. The most important use to which the coarser grasses can be applied is for litter; for which purpose, they may be placed in stables or yards, where, from the absorbent nature of their stems, they will necessarily take up the urine and other moist manures with which they come in contact.

8. It will be observed that clovers differ essentially in composition from the grasses : they are strictly lime and potash plants. Phosphoric acid is also equal in importance to any of the other elements. The silica amounts scarcely to one per centum.
9. When clover is removed from a field, and no returns are made, it is evident that it exhausts a soil quite as much as timothy. Thus 123 lbs. of inorganic matter are removed in a ton of clover hay, which consists mainly of expensive elements, viz. phosphoric acid, lime and potash, amounting in those three substances to 100 lbs.
10. It is also evident that we may apply the proper manures for clover. Gypsum is well known for this purpose; and the large quantity of lime which the plant yields on analysis, seems to indicate that gypsum is taken up immediately by the roots.

    The use of clover to the wheat crop is indicated in the composition of its ash. Besides acting mechanically in loosening the soil, it also furnishes the elements which the wheat plant requires: and it is probable, from the quantity of water in the stems

and leaves, and the small amount of silica in the clover plant, that it decays with more rapidity and more perfectly than the grasses, and hence its effects are more immediate than those of other green manures, excepting sea weeds. We have, then, in the large stems and roots of clover, a large amount of food for other plants, and which is so combined and constituted that it is soon ready for their uses after it is covered with earth.

In many instances, the crop of clover is too large to be ploughed in to advantage. In this case, farmers are in the habit of feeding it to their cattle. The proper course to be pursued is indicated by the crop itself. If it is small, the whole ought to be given to the succeeding crop : on the contrary, if large, it is useful to feed it down wholly or in part.

CHAPTER IV.

THE CEREALS,

CONSISTING OF OATS, BARLEY, MILLET, RYE, WHEAT AND INDIAN CORN.

The importance of the cereals to man has never been over-estimated. They constitute his food in all climates; and, without them, it would be difficult for the race to subsist. In their composition they contain the materials for bone, muscle and fat, and from these all the tissues are formed and supported. Hence the cultivation of the cereals has ever constituted one of our main employments, and indeed will, if any thing, become more and more the object of our attention. In consequence of their great value as sources from whence we derive our chief nutriment, we find that the soil upon which they grow is soon deprived of some of its essential elements, which, if not replaced, will end at last in so diminishing its fertility that the seeds will cease to be perfected; when the crop necessarily fails, and the farmer is obliged to lose his labor. It is for this reason that it becomes necessary to know what elements are removed from the soil, and how much is carried away in the crop when disposed of in a distant or even in a home market.

The possession of these facts enables the farmer to supply the specific losses he is continually sustaining. He need not be at a loss on this point, inasmuch as it is mainly the inorganic matter which is removed. It is that part which is contained in the ash, or which is left after the combustion of the plant. It may appear in many instances to be inconsiderable: yet, in ordinary soils, the effect of the crop is often perceptible in one year. In the highly favored counties of Western New-York, a long period has elapsed in the cultivation of wheat, without the accompanying signs of barrenness. This fact has been already explained in the first volume. It is well known that a very large portion of the western and central counties, those constituting the Fourth district, are underlaid by decomposing shales, which supply almost continually new and fresh matter for the wheat crop. If to this is also added the fact that gypsum and clover are liberally employed, the secret of constant fertility is explained. It can not be doubted that many large tracts of country in New-York have the best soil for wheat, all things considered, in the world.

Those tracts, however, are not the best for indian corn. This cereal requires a soil constituted somewhat differently from that which is most suitable for wheat: there should be a larger amount of the phosphates. There is a much larger growth of the plant itself;

or, the number of tons of the herbage of indian corn exceeds that of wheat. From this circumstance, alone, it is evident that it must take a greater amount yearly from the soil.

Wheat contains a larger amount of silica in its straw, than either of the other cereals. Barley is allied more intimately to lime plants, than wheat or oats.

It will be observed that more attention has been given to the composition of the ash of the cereals, than to their proximate elements, as gluten, albumen, casein, etc. It is true that the latter are important matters to be considered and determined : they, however, may be placed under the head of varieties, where it becomes necessary to compare two or more in order to determine their relative powers to supply nutriment. The analysis of the ash informs us more particularly of the effects of crops on soils, and lays the foundation for a natural system of culture. It does more than this; for we also learn from analysis the proportions of the phosphates and alkalies, which are of themselves so essential to the constitution of nutritious matters.

I. OATS.

The oats which have been subjected to analysis, were grown in four of the agricultural districts : the Southern, or Fifth; the Wheat, or Fourth; the Hudson-river, or the Third, and the Eastern, or Second, which is based upon the taconic slates.

From the Southern district I received specimens of oats from Mr. RANDALL of Cortlandville, and from Mr. N. SALISBURY of Scott, Cortland county. These oats grew upon the slates of the upper part of the Hamilton or Lower Chemung group. For an analysis of the soil, see p. 341, Vol. I.

1. Mr. RANDALL's *oats, straw and chaff.*

	PROPORTIONS.	
Grain	491·270	grs.
Straw	438·500	
Chaff	92·220	
Ash of the grain	10·400	grs.
Ash of the straw	21·120	
Ash of the chaff	3·566	
	Per centum.	
Water of the sun-dried grain	10·820	
Water of the husk	13·280	
Water of the straw, undetermined.		

2. *Analysis of the grain.*

	Per centum.
Silica	30·706
Phosphates	32·826
Lime	0·221
Magnesia	0·143
Potash	18·332
Soda	3·973
Sulphuric acid	1·674
Chlorine	0·463
Organic matter	5·447
	93·785

The loss in this instance is too great to pass unnoticed, but I am unable to account for it, unless it is to be attributed to water in the ash, which was not dried previous to analysis.

3. *Analysis of the straw.*

	Per centum.
Silica	24·450
Phosphates of lime, magnesia and iron	31·650
Carbonate of lime	6·050
Magnesia	0·200
Potash	17·990
Soda	3·140
Chlorine	0·490
Sulphuric acid	12·571
Organic acids	3·672
	100·213 B.

4. *Analysis of the chaff.*

	Per centum.
Silica	66·50
Phosphates	20·20
Carbonate of lime	0·20
Magnesia	0·10
Potash	5·62
Soda	3·73
Sulphuric acid	3·72
Chlorine	0·40
	100·47

In the chaff of all grains, a larger amount of silica is found than in the other parts. It seems to be required for the purpose of protecting the grain from casual injury, or it may be from insects.

The ash of the chaff amounts to - 3·56 per centum;
And of water to - - - - 7·00.

The chaff, from its thinness, is usually well dried in the sun, though it seems to absorb moisture from the atmosphere. These specimens had been exposed to the dry air of the heated room for some time previous to their analysis.

5. *Analysis of two specimens of oats, straw and its chaff :* one of the ripe oat, and the other immature, or cut when in blossom. It is the variety often known under the name of *Tantain oats.* Its stalk is large and vigorous: the grain is blackish. It was furnished by Mr. NATHAN SALISBURY, of Scott, Cortland county, and was grown upon the Chemung shales above the Tully limestone.

PROPORTIONS.

Unripe Tantain oats (in blossom) sun-dried.

Water - - - - - - - -	9·48
Ash - - - - - - - -	3·15
Calculated dry - - - - - - - -	3·48

Ripe Tantain oats.

Water - - - - - - - -	9·53
Ash - - - - - - - -	2·37
Calculated dry - - - - - - - -	2·61

Straw of the unripe oat.

Water - - - - - - - -	8·40
Ash - - - - - - - -	5·06
Calculated dry - - - - - - - -	5·52

Straw of the ripe oat.

Water - - - - - - - -	8·33
Ash - - - - - - - -	7·30
Calculated dry - - - - - - - -	7·96

Chaff of the unripe oat.

Water - - - - - - - -	9·10
Ash - - - - - - - -	5·94
Calculated dry - - - - - - - -	6·53

Chaff of the ripe oat.

Water - - - - - - - -	11·99
Ash - - - - - - - -	5·61
Calculated dry - - - - - - - -	6·38

6. *Analysis of the ripe straw of the black Tantain oats.*

	30·000 grs.	Calculated without carbonic acid or organic matter.
Silica	2·815	13·399
Phosphates	1·870	8·902
Carbonate of lime	1·525	7·259
Magnesia	0·094	0·448
Potash	12·613	60·035
Soda	0·761	3·622
Sulphuric acid	1·209	5·754
Chlorine	0·581	0·581
Carbonic acid	6·140	
Organic acids	2·400	
	30·018	100·000

7. *Analysis of the unripe straw of the same.*

	30·000 grs.	Calculated without carbonic acid or organic matter.
Silica	4·355	19·540
Phosphates	3·345	14·666
Carbonate of lime	1·628	7·140
Magnesia	1·064	4·666
Potash	9·256	40·598
Soda	1·437	6·302
Sulphuric acid	1·364	5·912
Chlorine	0·350	1·176
Carbonic acid	5·939	
Organic acids	1·300	
	30·099	100·000

	Removed in a ton of ripe straw.	Removed in a ton of unripe straw.
Silica	21·907 lbs.	22·100 lbs.
Phosphates	14·555	16·587
Carbonate of lime	11·868	8·075
Magnesia	0·732	5.277
Potash	98·157	45·915
Soda	5·921	7·128
Sulphuric acid	9·408	6·686
Chlorine	0·950	1·330
	163·498	113·098

I propose giving in this place an analysis of the straw of the same oat, divided into two parts, bottom and top; the division being made about midway between the two points. It shows a fact which we have been conversant with a long time, namely, that parts of

the same organ may and do differ in composition. This difference is no doubt due in part to the ascent of fluids, after the roots have performed their office; or, in other words, to the law of the upward and outward movements of the sap, which has been already referred to.

I. ANALYSIS OF THE STRAW OF THE TANTAIN OAT.

1. *Unripe oat straw.*

	Top.	Bottom.
Silica	14·939	19·823
Phosphates	23·959	13·039
Carbonate of lime	5·921	11·336
Magnesia	1·206	3·125
Potash	45·072	43·541
Soda	2·200	1·251
Sulphuric acid	4·206	5·016
Chlorine	2·497	2·866

2. *Ripe oat straw.*

	Top.	Bottom.
Silex	14·839	12·417
Phosphates	10·637	9·355
Carbonate of lime	8·765	8·939
Magnesia	0·774	0·604
Potash	50·623	53·484
Soda	7·727	5·994
Sulphuric acid	4·044	6·800
Chlorine	2·586	2·395

It will be observed, that in the four preceding analyses, the percentage is calculated without organic matter or carbonic acid, both of which necessarily vary in every kind of ash.

3. *Analysis of the phosphates of the unripe straw.*

	Top.	Bottom.
Phosphates	4·290	2·220
Phosphate of peroxide of iron	0·210	0·180
Lime	0·698	0·698
Magnesia	0·840	0·597
Silicic acid	trace.	0·060
Phosphoric acid	2·542	0·685

II. ANALYSIS OF THE CHAFF OF THE TANTAIN OAT.

1. 15 *grs. ash of unripe chaff.*

		Per centum.
Silex	4·750	31·660
Phosphates	3·300	22·000
Carbonate of lime	0·850	5·660
Magnesia	0·384	2·560
Potash	2·081	13·860
Soda	0·341	2·260
Chlorine	0·423	2·820
Sulphuric acid	0·841	5·600
Carbonic acid	1·383	9·220

2. 20 *grs. ash of the ripe chaff.*

		Per centum.
Silex	7·060	35·300
Phosphates	3·102	15·510
Carbonate of lime	3·254	16·270
Magnesia	0·244	1.220
Potash	2·150	10·650
Soda	0·431	2·155
Chlorine	1·234	6·170
Sulphuric acid	1·920	9·600

3. *Analysis of the phosphates of the chaff of the ripe oat.*

Phosphates	3·10
Phosphate of peroxide of iron	0·50
Lime	0·83
Magnesia	0·99
Silicic acid	trace.
Phosphoric acid	0·78

III. ANALYSIS OF THE RIPE GRAIN OF THE TANTAIN OAT.

	20·000 grs.
Silica	4·220
Phosphates	7·360
Carbonate of lime	0·050
Magnesia	0·016
Potash	2·947
Soda	0·534
Sulphuric acid	0·207
Chlorine	0·297
Phosphate of potash and soda	1·023
Carbonic acid	1·757

IV. ANALYSIS OF OATS FROM GENESEE COUNTY.

Raised by Judge PETERS. Variety unknown. The soil is that peculiar clay loam which is adapted to wheat, and belongs to the Onondaga-salt group.

	PROPORTIONS.
Straw	703·20 grs.
Grain	765·50
Chaff	143·70

100 grs. dried in the sun, gave

Straw	4·875 grs. of ash.
Chaff	6·875
Grain	2·750

An unfinished analysis of the grain and chaff.

	Grain.	Chaff.
Silica	39·80	45·00
Phosphates	27·50	11·00
Carbonate of lime	0·10	trace.
Magnesia	0·09	0·01
Potash	12·65	8·22
Soda	5·32	4·52

EXPERIMENT WITH THE OAT CROP.

In accordance with the wish of the State Agricultural Society, I have made several analyses of soils and oats growing upon them, for the purpose of throwing additional light on the value of manures, and the exhausting power of different crops. The Society had offered a premium for experiments on three acres of ground, with three successive crops. These experiments were to be conducted in the following manner : 1. The acres to be contiguous to each other : 2. One acre was to be manured with not less than ten cords of common barnyard manure the first year, and plowed under; the second acre to be manured with fermented or composted manure, and the other acre to receive no manure : 3. The three acres to be planted with corn the first year; the second, to be sowed with barley or oats; and the third year, to be cultivated with winter grain. Only one gentleman undertook the execution of the experiment : Mr. I. F. OSBORN, Port Byron, Cayuga county.

It is proper to remark, that I have been supplied with the soil since the first crop was taken off. The soil which was supplied for the purpose of examination, to show what it was before the experiments began, was taken from the outskirts of the field. It was the

intention, in the selection of the soil, to show, first, what it was; and then to show what it became after the removal of the crops. Accordingly, two specimens of soil from each acre were sent me for analysis : the first, to show what it was; and the second, to show what it is; but as the selection was made as I have stated, it is evident that the analyses will be less satisfactory than if they had been made in a different manner.

The only crop which has been forwarded for analysis, is the oat crop, a specimen from each of the three acres; but the oat was incomplete, inasmuch as it was cut off about eighteen inches from the ground, leaving about one half or two-thirds of the straw. It is important to state these imperfections in the experiments. Besides it is stated that the acre which is unmanured is naturally the richest; a fact which was suspected in the analysis of the oat.

I will now proceed to the details of the analyses; premising, however, that my object in engaging in them was to throw more light on the composition of the soil of the Wheat district. The soil, as decribed by Mr. OSBORN, is a gravelly loam, with a clay subsoil from eight to sixteen inches deep. For further details of the experiments, the reader is referred to the State Agricultural Society's Transactions for 1847.

ANALYSIS OF THE SOILS REFERRED TO IN THE PRECEDING REMARKS.

I. The east acre was manured with ten cords of barnyard manure, which was hauled on while wet, and spread as fast as it could be ploughed in. One hundred grains of the soil were saturated with moisture; 26·886 grs. of water were absorbed, leaving 73·114 of dry soil.

Another 100 grs. gave

	Soil as it was.
Organic matter	5·390
Water	1·905
Silica	84·375
Alumina, peroxide of iron and phosphates	5·870
Soluble silica	0·145
Carbonate of lime	0·243
Magnesia	0·025
Potash	0·164
Soda	0·485
Chloride of sodium	0·012
Sulphuric acid	0·004
Carbonic acid not appreciable.	
	98·618 S.

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The only crop which has been forwarded for analysis, is the oat crop, a specimen from each of the three acres; but the oat was unripe, inasmuch as it was cut off about eighteen inches from the ground, leaving about one half in two-thirds of the straw. It is important to state these important facts in the experiments. Besides it is stated that the acre which is unmanured is naturally the richest; a fact which was suspected in the analysis of the oat.

I will now proceed to the results of the analyses; premising, however, that my object in engaging in them was to take a correct view in the composition of the soil of the Wheat District. The soil, as described by Mr. OSBORN, is a gravelly loam, with a clay subsoil from eight to sixteen inches deep. For further details of the experiments, the reader is referred to the State Agricultural Society's Transactions for 1847.

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Another 100 grs. gave

	Substances.
Organic matter	5·390
Water	1·965
Silica	84·375
Alumina, peroxide of iron and phosphates	5·870
Soluble silica	0·245
Carbonate of lime	0·243
Magnesia	1·025
Potash	0·164
Soda	0·485
Chloride of sodium	0·012
Sulphuric acid	0·494
Carbonic acid not appreciable.	
	96·618 S.

According to this analysis, the soil, to the depth of one foot, contained

Organic matter	366856·875 lbs.
Lime	16539·187
Magnesia	1701·562
Potash	11182·250
Soda	33010·312
Chloride of sodium	816·750
Sulphuric acid	272·250
Soluble silica	9869·062

The phosphates were appreciable, but too small in amount to be weighed.

It may be repeated in this place, that the soils of the true Wheat district are not so rich in phosphates as the soils of the Hudson river and Eastern districts.

The following exhibits the soil of the east acre as it is, or after a crop of corn and oats (I believe) have been removed, but which had been highly manured as stated in the foregoing remarks.

One hundred grains, saturated with moisture, gave

	Soil as it is.
Water	28·686
Dry soil	71·314

100 grs. of dry soil gave

Organic matter	6·935
Water	2·765
Silica	82·725
Alumina and peroxide of iron	5·360
Soluble silica	0·025
Lime	0·217
Magnesia	0·092
Potash	0·032
Soda	0·444
Chloride of sodium	0·022
Sulphuric acid	0·013
Phosphates appreciable.	
Carbonic acid not appreciable.	
	98·630 S.

According to this analysis, the acre, to the depth of one foot, contains

Lime	14769·562 lbs.
Organic matter	472013·437
Magnesia	6261·750
Potash	2178·000
Soda	30219·750
Chloride of sodium	1497·375
Sulphuric acid	884·812
Soluble silica	1701·562

For obvious reasons, the calculations are confined to those elements which exist in the smaller quantities. We have only to compare the analyses and the calculations, to form an opinion of the effects of cultivation. It is supposed that the greater absorbent power of the soil as it is, is due to the organic matter in part added in the manure; inasmuch as we have fully shown, in another place, that the absorbent power of a soil is mostly due to the presence of organic matter.

II. The soil of the middle acre was left unmanured; but it is remarked that it is naturally the best soil of the three acres, as it receives the wash of adjacent lands.

1. *Soil of the middle acre as it was.*

One hundred grains, saturated with moisture, gave

Water	25·823
Dry soil	74·177

100 grs. of dry soil gave

Organic matter	4·085
Water	2·220
Silica	85·185
Alumina and peroxide of iron	5·610
Soluble silica	0·075
Lime	0·198
Magnesia	0·044
Potash	0·158
Soda	1·093
Chloride of sodium	0·019
Sulphuric acid	trace.
Phosphates appreciable.	
	98·687 S.

According to the analysis, the middle acre contains, in the depth of one foot,

Organic matter - - - - -	278035·312 lbs.
Lime - - - - - - -	13476·375
Magnesia - - - - - -	2994·750
Potash - - - - - - -	10753·875
Soda - - - - - - -	74392·312
Chloride of sodium - - - -	1293·875

2. *Soil of the middle acre as it is.*

100 grs. saturated with moisture, gave

Water - - - - - - - - -	23·641
Dry soil - - - - - - - -	76·359

In one hundred grains of the dry soil, there was found

Organic matter - - - - - -	3·660
Water - - - - - - - -	1·875
Silica - . - - - - - -	87·975
Alumina and peroxide of iron - - -	3·880
Soluble silica - - - - - -	0·305
Lime - - - - - - - -	0·155
Magnesia - - - - - - -	0·044
Potash - - - - - - -	0·044
Soda - - - - - - - -	0·772
Chloride of sodium - - - - -	0·020
Sulphuric acid - - - - - -	trace.
Phosphates appreciable.	
	98·730 S.

There is, therefore, contained in the acre, to the depth of one foot,

Organic matter - - - - -	249004·750 lbs.
Lime - - - - - - -	10549·687
Magnesia - - - - - -	2994·750
Potash - - - - - - -	2994·750
Soda - - - - - - -	52544·250
Soluble silica - - - - -	224946·562
Chloride of sodium - - - -	1361·250

III. The soil of the west acre was prepared with rotted or partially rotted manure.

1. *Soil of the west acre, as it was.*

One hundred grains, saturated with moisture, gave

Water - - - - - - - -	25·161
Dry soil - - - - - - -	74·839

100 grs. of the dry soil gave

Organic matter - - - - - -	4·115
Water - - - - - - - -	1·470
Silica - - - - - - - -	86·095
Alumina and peroxide of iron - - -	5·615
Soluble silica - - - - - -	trace.
Lime - - - - - - - -	0·172
Magnesia - - - - - - -	0·242
Potash - - - - - - - -	0·032
Soda - - - - - - - -	0·208
Chloride of sodium - - - - -	0·010
Sulphuric acid - - - - - -	0·002
Phosphates appreciable.	
	97·960 S.

The soil of this acre contained, in the depth of one foot,

Organic matter - - - - -	300077·187 lbs.
Lime - - - - - - -	11706·750
Magnesia - - - - - -	16471·125
Potash - - - - - -	21788·000
Soda - - - - - - -	14157·000
Chloride of sodium - - - -	680·625
Sulphuric acid - - - - -	136·125

PROPORTIONS.

1. EAST ACRE.

	Quantity.	Per centum.
GRAIN	510·300	
Water		9·412
Ash	12·780	2·504
CHAFF	67·580	
Ash	3·675	5·438
STRAW	225·100	
Ash	13·459	5·975

2. MIDDLE ACRE.

	Quantity.	Per centum.
GRAIN	631·000	
Water		10·400
Ash	15·120	2·396
CHAFF	80·880	
Ash	5·675	7·016
STRAW	244·000	
Ash	12·500	5·122

3. WEST ACRE.

	Quantity.	Per centum.
GRAIN	712·300	
Water		10·120
Ash	16·690	2·343
CHAFF	95·800	
Ash	5·680	5·925
STRAW	359·800	
Ash	24·940	6·931

I. COMPOSITION OF THE OATS OF EACH ACRE RESPECTIVELY.

1. EAST ACRE.

1. *Ash of the grain.*

	20·000 grs.	Per centum : calculated without coal or carbonic acid.
Silica	5·140	30·382
Coal	0·180	
Phosphates	4·740	28·017
Carbonate of lime	0·020	0·112
Magnesia	0·010	0·056
Potash	3·800	22·461
Soda	1·012	5·923
Sulphuric acid	0·501	2·661
Chlorine	0·305	1·802
Phosphate of potash and soda	1·500	8·330
Carbonic acid and organic matter	2·613	
	19·821	99·444

2. *Ash of the straw.*

	25·000 grs.	Calculated without organic matter.
Silica	1·275	5·587
Phosphates	5·125	22·450
Carbonate of lime	0·970	4·247
Magnesia	0·180	0·788
Potash	12·568	55·048
Soda	0·943	4·132
Chlorine	0·910	3·983
Sulphuric acid	0·865	3·788
Organic matter	1·380	
	24·216	100·023

3. *Ash of the chaff.*

Silica	11·360
Phosphates	3·250
Carbonate of lime	0·385
Magnesia	0·196
Potash	3·292
Soda	0·269
Sulphuric acid	0·423
Chlorine	0·268
Organic matter	0·443
	19·886

COMPOSITION OF THE PHOSPHATES.

PHOSPHATES	3·250
Silica	0·060
Phosphate of peroxide of iron	0·250
Magnesia	0·207
Lime	0·924
Phosphoric acid	1·809

2. Middle acre.

1. *Ash of the grain.*

	Per centum calculated on the elements as obtained without carbonic acid or coal.
Silica	37·527
Phosphates	33·581
Carbonate of lime	0·171
Magnesia	0·070
Potash	15·172
Soda	5·438
Sulphuric acid	1·288
Chlorine	1·623
Phosphates of potash and soda	4·210
	99·080

2. *Ash of the straw.*

	25·000 grs.	Calculated without carbonic acid or organic matter.
Silica	8·890	37·160
Phosphates	1·365	5·703
Carbonate of lime	3·080	12·874
Magnesia	0·328	1·368
Potash	9·134	38·178
Soda	0·407	1·698
Chlorine	0·129	0·535
Sulphuric acid	0·577	2·409
Organic matter	0·800	
Carbonic acid	1·601	
	26·311	99·925

3. *Ash of the chaff.*

	25·000 grs.	Per centum: calculated without carbonic acid or organic matter.
Silica	14·240	58·976
Phosphates	1·620	6·698
Carbonate of lime	0·850	3·520
Magnesia	0·248	1·026
Potash	6·765	27·015
Soda	0·199	0·822
Sulphuric acid	0·201	0·829
Chlorine	0·131	0·541
Organic matter and carbonic acid	1·639	
	25·993	99·467

COMPOSITION OF THE PHOSPHATES.

Soluble silica	0·160
Phosphate of peroxide of iron	0·180
Magnesia	0·071
Lime	0·259
Phosphoric acid	0·950

3. WEST ACRE.

1. *Ash of the grain.*

	Per centum: reckoned without carbonic acid or foreign matter.
Silica	33·129
Phosphates of lime, iron and magnesia	29·463
Lime	0·070
Magnesia	0·084
Potash	18·904
Soda	5·751
Sulphuric acid	2·135
Chlorine	0·028
Phosphates of potash and soda	10·291
	99·855

2. *Ash of the straw.*

		20·000 grs.	Calculated without carbonic acid or organic matter.
Silica		2·800	16·656
Phosphates:			
of iron	0·120		
of lime	0·188		
of magnesia	0·025		
Phosphoric acid	0·667		
		1·000	5·952
Carbonate of lime		1·470	8·745
Magnesia		0·475	2·827
Potash		8·818	52·483
Soda		1·088	6·475
Sulphuric acid		0·721	4·291
Chlorine		0·321	1·905
Organic matter		0·960	
Carbonic acid		3·106	
		20·759	99·334

3. *Ash of the chaff.*

	20·000 grs.	Calculated without coal, carbonic acid or organic matter.
Silica	7·500	44·876
Coal	1·120	
Phosphates	2·900	17·348
Carbonate of lime	1·090	6·520
Magnesia	0·098	0·582
Potash	4·200	25·130
Soda	0·890	5·324
Carbonic acid and organic matter	1·742	
	19·540	99·800

COMPOSITION OF THE PHOSPHATES.

Silica	0·03
Phosphate of iron	0·04
Lime	0·05
Magnesia	0·31
Phosphoric acid	1·91

COMPOSITION OF THE PHOSPHATES OF THE GRAIN OF EACH ACRE.

	West.	Middle.	East.
Soluble silica	0·025	0·030	0·030
Phosphate of peroxide of iron	0·375	0·190	0·190
Magnesia	1·234	1·314	1·234
Lime	0·727	0·665	0·694
Phosphoric acid	2·839	3·201	2·592

II. Organic constituents of the oat or grain of each acre respectively.

1. East acre.

236·40 grs. oats yielded of

		Percentage.
Paleæ or husks	69·30	29·314
Kernels	167·10	70·686

194·16 grs. kernels gave of

Fine white flour	115·12	59·291
Bran (about like that separated at the mills)	79·02	40·709

Flour.

115·12 grs. flour gave of

Starch	89·91	77·232
Epidermis, pilose*, gluten and oil	4·32	3·752

Percentage of ash in the epidermis and pilose (mostly pilose) 2·315. Nothing more was obtained from this specimen of flour.

* The pilose is the short hairs appended to the epidermis.

Percentage of water, dry matter and ash in the kernels.

100 grs. of kernels yielded of

Water	9·412
Dry kernels	90·588
Ash	5·242
Ash calculated dry	2·475
Organic matter calculated dry	97·525

Kernels.

100 grs. of kernels gave of

		Percentage: calculated dry.
Starch	55·000	59·291
Albumen	1·800	1·932
Casein or avenine	15·769	16·984
Dextrine, or gum and mucilage	7·280	7·861
Oil	3·380	3·644
Gluten	1·680	1·803
Sugar and extractive matter	2·120	2·278
Epidermis and pilose	5·750	6·207
Water	9·412	
	102·582	100·000

2. Middle acre.

289·06 grs. gave of

		Percentage.
Paleæ or husk	89·06	30·810
Kernels	200·00	69·190

196·40 grs. kernels yielded of

Fine white flour	114·000	58·045
Bran (about as it is obtained at the mills)	82·400	41·955

Flour.

100 grs. of the flour gave of

Starch	82·70
Epidermis, gluten, oil and pilose, mostly pilose	2·28

Percentage of ash in pilose 3·289. This gave no Co_2, a large percentage of silicic acid, a small quantity of phosphates, lime and magnesia, and a mere trace of So_3.

Casein	2·16
Dextrine or gum	1·68
Water	10·40

The sugar, extractive matter, oil, gluten and albumen were not quantitatively obtained (very small, mostly in bran).

Bran.

82·40 grs. of bran gave of

Starch	35·155	42·664
Casein and mucilage	9·175	11·135
Dextrine or gum	6·630	8·046
Epidermis, pilose, gluten and oil	13·870	16·832
	64·830	78·577

Percentage of ash in epidermis and pilose 3·466, mostly epidermis. This ash contains considerable silex, a large proportion of phosphates, and a small proportion of lime, magnesia and sulphuric acid. No effervescence on adding acid to ash.

The albumen, sugar, extractive matter, gluten and water were not obtained. These, with loss, amount to - - 17·570 21·323

82·400 100·000

Kernels.

100 grs. of kernels gave of

		Percentage: calculated dry.
Starch	57·220	65·412
Casein or avenine	12·120	13·897
Albumen	0·820	0·941
Gluten	1·400	1·605
Dextrine, or gum and mucilage	6·340	7·269
Sugar and extractive matter	1·260	1·445
Oil	4·740	5·435
Epidermis and pilose	3·310	3·796
Water	10·145	
	97·355	100·000

3. West acre.

Kernels.

100 grs. kernels gave of

		Percentage: calculated dry.
Starch	55·34	60·336
Casein or avenine	14·36	15·656
Albumen	0·94	1·025
Gluten	1·62	1·766
Dextrine, or gum and mucilage	9·26	10·096
Sugar and extractive matter	2·28	2·486
Oil	7·50	8·177
Epidermis and pilose	0·42	0·458
Water	10·12	
	101·84	100·000

Flour.

100 grs. of the flour gave of

		Percentage: calculated dry.
Starch	79·360	92·667
Casein or avenine	2·120	2·475
Dextrine or gum	1·660	1·939
Epidermis, pilose, gluten and oil	2·500	2·919
Water	9·714	
	95·354	100·000

The sugar, extractive matter and albumen were not obtained.

Proportion of paleæ and kernels.

Paleæ or husks	29·052
Kernels	70·948

Proportion of flour and bran in kernels.

Flour	58·958
Bran	41·042

ANALYSIS OF OATS FROM LEWIS COUNTY.

This variety, which I have noticed under this name, grew upon the black slates of the Hudson-river group, which is usually a mixture of flat and round gravel and loam. The following is its composition:

WHITE OAT.

Water of the grain	10·10	
	15·000 grs.	Percentum: calculated without organic matter.
Silica	5·860	43·030
Phosphate of iron	0·160	1·174
Phosphate of lime	0·250	1·836
Phosphate of magnesia	1·431	10·503
Phosphoric acid	2·030	14.904
Carbonate of lime	0·020	0·141
Magnesia	0·010	0·067
Potash	1·998	14·667
Soda	1·346	9·892
Chlorine	0·261	1·800
Sulphuric acid	0·253	1·836
Organic matter	1·203	
Carbonic acid	trace.	
	14·822	99·850

The following is the composition of a black oat from the same locality, cultivated in the same manner, and upon the same soil :

	Black oat.	
Water in the grain	9·88	
	15·000 grs.	Per centum : calculated without organic matter.
Silica	6·030	43·177
Phosphate of iron	0·180	1·287
Phosphate of lime	0·330	2·357
Phosphate of magnesia	0·673	4·817
Phosphoric acid	1·997	14·295
Carbonate of lime	0·040	0·284
Magnesia	0·010	0·067
Potash	1·491	10·670
Soda	1·342	9·606
Phosphate of potash and soda	1·680	12·025
Chlorine	0·125	0·894
Sulphuric acid	0·062	0·440
Carbonic acid	trace.	
Organic matter	0·800	
	14·760	99·919

ANALYSIS OF A CAREX FROM BEMENT'S FARM.

[Received too late to be inserted in its proper place. See p. 81.]

Cut June 10th, just before the flower spikes made their appearance : from 24 – 36 inches high.

100 grs. of fresh grass gave

Water	71·783
Dry matter	28·217
Ash	1·538
Ash calculated dry	5·451
Organic matter calculated dry	94·549 S.

ANALYSIS OF OATS FROM PITTSTOWN.

Furnished by Mr. NEWCOMB. It was grown upon the soil resting upon the Taconic slates. The oat was fully ripe, with bright grain and straw.

1. *Relative proportion of grain, straw and chaff.*

	Actual quantities.
Grain	636·000
Straw	566·000
Chaff	60·000

2. *Analysis of the grain.*

	20·000 grs.	Per centum: calculated without organic matter.
Silica	8·100	41·449
Phosphates of lime and magnesia	6·110	31·264
Carbonate of lime	trace.	
Magnesia	none.	
Potash	2·051	10·495
Soda	1·966	10·059
Chlorine	0·017	0·100
Sulphuric acid	0·013	0·065
Phosphate of potash and soda	1·280	6·545
Carbonic acid	none.	
Organic matter	0·412	
	19·949	100·077

3. *Analysis of the straw, divided into two equal parts, top and bottom.*

	Top.	Bottom.
Silica	7·070	4·200
Phosphates	2·615	2·240
Carbonate of lime	0·990	0·280
Magnesia	0·043	0·108
Potash	6·559	7·833
Soda	1·233	1·463
Sulphuric acid	0·310	0·338
Chlorine	0·093	0·061
Carbonic acid	1·012	3·145
	19·925	19·668

4. *Analysis of the chaff.*

Silica	10·375
Coal	0·480
Phosphates	0·935
Carbonate of lime	0·800
Magnesia	0·570
Potash	0·430
Soda	0·309
Sulphuric acid	0·447
Chlorine	0·123
	14·569

ANALYSIS OF THE STRAW OF OATS GROWN BY Mr. PETERS*.

Silica	12·350
Phosphate of peroxide of iron	0·925
Lime	6·247
Magnesia	1·945
Silicic acid	5·575
Phosphoric acid	4·933
Lime	0·761
Magnesia	1·750
Potash	38·871
Soda	3·792
Chloride of sodium	0·214
Sulphuric acid	0·048
Carbonic acid	10·160
Organic matter	3·300
	99·871 S.

* This analysis should have been inserted at page 97. The foregoing organic analyses of the oat of the three experimental acres were made by Mr. Salisbury, assistant in the laboratory.

REMARKS UPON THE OAT CROP.

The oat crop is very properly regarded, in all the temperate and more northerly countries, as one of the most important. In some it is highly esteemed in domestic life as a grain for bread, and everywhere as one of the best kinds for cattle. Hence it is extensively cultivated: it therefore becomes proper to make a few inquiries as to its exhausting powers upon the soil, and as to the grounds upon which its reputation rests as an article of food for man and beast.

The weight of this grain varies from thirty to thirty-four pounds per bushel, and a fair crop will not vary much from fifty bushels to the acre. Premium crops have been given, amounting from eighty-five to ninety bushels per acre. From these data, we may determine the amount of mineral matter removed from the soil in a given crop of oats. The per centum of mineral or inorganic matter will be as follows, taking 5·25 as the average per centum of the ash. Hence there will be removed

	In one bushel of grain.	From an acre.
Silica or silicic acid	8·960 oz.	28·150 lbs.
Phosphates	8·000	25·000
Carbonate of lime	0·019	0·059
Magnesia	0·022	0·071
Potash	5·141	16·068
Soda	1·564	4·888
Chlorine	0·007	0·023
Sulphuric acid	0·580	1·814
Phosphates of potash and soda	2·799	8·747
	27·092 oz.	84·820 lbs.

For the foregoing calculation, I have taken the analysis of the ash of the oat of the middle acre (p. 107). Each analysis will give a result differing somewhat from this; but this single calculation will be sufficient for our purpose, that is to show how much a given crop will remove of these valuable substances from the soil.

The oat crop, it will be seen, may be regarded as one of the exhausting crops. We are not, however, prepared here to enter upon a comparison of this crop with those of the other cereals, as this will necessarily come up for consideration after I have given the analyses of the other grains. But I may now proceed to the important question, What elements does the oat possess, which render it a valuable article of food?

It seems proper, in the first place, to state that the value of food, or of matters to support and sustain life, do not depend upon any one single element. The idea that nitrogen is the important one, is entirely fallacious. It is true that high authorities are wedded to the notion that nitrogren is the body which sustains animal life. Hence when the quantity of nitrogen has been determined, the substance has a station given it in the list of nutriments, according to the amount of nitrogen it contains. It is, however, no more important than starch, or any of the other respiratory products. I assume this position, because I believe

there is a mutual relation subsisting among the elements. Life does not consist simply in the formation of muscle, nor of bone. The acts of life are seen equally in respiration, as in digestion; in supplying heat, as in supplying nutriment; in supplying a bony frame-work, as in giving it motion. Each element has its use, and each organ its function; and not one of them can fail in the performance of its office, without deranging the whole fabric. Sulphuric acid, or oil of vitriol, is wanted in the animal economy; so are brimstone and phosphorus, two highly combustible bodies; and no doubt there are instances when life is too fully charged with them, still they are as necessary as nitrogen, and life would not manifest itself without their aid.

We may therefore regard a body important to animal life, in proportion as it contains the requisite number of all those elements which a living body requires to give it the greatest degree of strength and energy. We may, with this view, look first to the inorganic bodies, potash, soda, lime and magnesia. In the same list, too, we may put the acids which combine with these bases, as the phosphoric and sulphuric, together with chlorine. These by themselves are useless in the absence of oxygen, carbon, hydrogen and nitrogen. The four last, but especially carbon and oxygen, enter largely into the composition of living beings. The tissues of vegetables, as well as of animals, seem to be mostly composed of carbon, oxygen and hydrogen, which, always taken in combination with the above bases, constitute a frame-work, delicate indeed, but yet essential to the performance of any function the tissue in its organic capacity is designed for. Nitrogen enters only into a certain class of organs; in others it is entirely absent, as in the bones. In the red and fleshy parts, nitrogen is an essential constituent; but even in these parts, iron, oxygen, hydrogen and the phosphates are equally important. A cereal, then, which contains the elements of bone and muscle in combination, or matter for the formation of the tissues generally, together with the maintenance of respiration, is the fittest nutriment in the economy of life.

Of the inorganic constituents of the oat, we have found the phosphates in the ratio nearly of $\frac{1}{6}$ or $\frac{1}{5}$; potash in about the same quantity, in some instances in a greater ratio. Soda and sulphuric acid are also always present. Lime and magnesia, together with silica, make up an important though short list of matters which are essential to the constitution of bone, muscle and brain.

In the list of bodies which are found by approximate organic analysis, are, starch, which exists in the ratio of $\frac{1}{2}$ of the products, is a respiratory and fat-producing substance; avenine, a nitrogenous element, in the ratio of $\frac{1}{4}$; gluten and albumen, two other nitrogenous bodies, in a much smaller ratio; oil and sugar, two other respiratory and fat-producing bodies, are in the ratio of $\frac{1}{12}$; dextrine and mucilage, which probably contribute to the same end, but which also act favorably as demulcents upon the mucous membrane of the alimentary canal. With such a composition it is satisfactorily made out that the oat is a valuable nutriment, taking the word in its widest sense. It has the materials for bone and muscle, as well as for respiratory matters; and it is not deficient in the elements of fat, that substance which gives fulness and beauty to the form. Experience, however,

had in generations long past established the same facts; and man, by his steady cultivation of the crop, has shown the estimation in which it has ever been held by him. It becomes still more important, from the fact that it may be cultivated in higher latitudes than some of the other cereals, and rarely in a northern climate disappoints the farmer.

The amount of organic elements in a bushel of oats weighing 32 lbs. is as follows:

	lbs.	oz.
Starch	17	4
Casein or avenine	4	9
Albumen	0	4
Gluten	0	8
Dextrine	2	15
Sugar and extract	0	11
Oil	2	6
Water	3	4
	32	0

Diseases of the oat.

The oat, in certain fields, especially those that are weedy, is subject to disease; or rather to the attack of a fungous plant, whereby almost every kernel upon the panicle or head is totally destroyed. This fungus is called by authors *Uredo avenæ*. It is a species of smut. The kernels, or the places where they would have grown, is filled with a black smutty substance, which finally becomes dry enough to send out a powder of extreme fineness, which is really a cloud of seeds capable of germinating and growing, and producing, like other seeds, individuals similar to the parent.

The smutty heads are well known undoubtedly to farmers, inasmuch as many may be found in most fields of oats. In addition to the smutty panicle, the whole plant is stinted, being shorter and more erect than the healthy one. The coverings of the grain, the husks, are apparently corroded through, so as to show upon the side the black mass within them. The spores, or seeds which have been already alluded to, are extremely minute rounded particles, whose forms are only made known by the aid of a powerful microscope. They are globular grains, not uniform in size, but with a diameter which does not exceed $\frac{1}{1111}$ of an inch. These minute atoms are scattered over the field, and lodged in the soil; and, without doubt, if we may rely upon analogy, they retain for a long time the power of germinating, and will do so when a favorable opportunity occurs. This fact renders it highly desirable that every smutty plant should be eradicated and burnt, when it first shows any symptoms of the disease in question; for undoubtedly the spores are taken up by the roots, and conveyed to heads of the grain, where they at once begin the work of destruction.

The fungous plant, which appears so much like a gangrene of the grain, is represented on Plate LV, fig. 23, in the first stage of its growth. It, however, more frequently appears

as in Plate LIV, fig. 2, where the plant is upright, rigid and dwarfish, as if the whole system had been poisoned. Figs. 24 and 25 represent the spores, under a high magnifying power; and so also Plate LIV, fig. 3 represents them as seen in plants by myself this season. In many fields, the smutty heads are very numerous.

II. RYE.

The specimens were procured from Arbor Hill, near the city of Albany, the soil being a gravelly loam based upon Albany clay. Heavy beds of drift frequently occur, which aid in giving a rolling surface to the country.

The plant was divided into parts, as grain, leaves, and top and bottom straw.

1. Unripe rye.

Plant in blossom, and cut June 18, 1847.

PROPORTIONS.

1. *Heads.*

	Per centum.
Water	67·5600
Dry heads	32·4400
Ash	1·5300
Ash calculated dry	4·7165

2. *Straw divided in two parts, top and bottom, and separated between the 3d and 4th joints.*

	Top.	Bottom.
Water	55·2600	61·7000
Dry straw	44·7400	38·3000
Ash	1·0010	1·2500
Ash calculated dry	2·2351	3·2637

3. *Leaves and leaf-sheaths.*

Water	69·8400
Dry leaves	30·1600
Ash	1·6300
Ash calculated dry	5·4045 S.

2. Ripe grain and straw.

Growth large : straw divided between the 3d and 4th joints.

PROPORTIONS.

	Per centum.	
Grain	43·206	
Chaff	8·356	
1. Top of the straw	15·892	39·069
Bottom	23·177	
Leaves and sheaths	9·360	

2. *Straw.*

	Top.	Bottom.
Water	8·127	7·603
Dry straw	91·878	92·397
Ash	3·572	2·343
Ash calculated dry	3·888	2·536

3. *Leaves.*

Water	7·933
Dry leaves	92·066
Ash	5·383
Ash calculated dry	5·847

4. *Chaff.*

Water	9·018
Dry chaff	90·982
Ash	9·042
Ash calculated dry	9·885

5. *Grain.*

Water	9·8450
Dry grain	90·1550
Ash	1·0445
Ash calculated dry	1·1585 S.

3. Analysis of the ash of the heads of rye.

Cut June 18, when in blossom.

Silica		61·800
Coal		4·000
Phosphates:		
of peroxide of iron	1·500	
Lime	3·102	
Magnesia	2·700	
Silicic acid	trace.	
Phosphoric acid	9·798	
		17·100
Lime		0·507
Magnesia		trace.
Potash		0·266
Soda		none.
Chloride of sodium		12·600
Sulphuric acid		4·296
Chloride of potassium		1·586
Organic acids		6·080
		104·211 S.

The heads, in this period of growth, are remarkable for the small amount of potash, and the absence of soda, except in combination with chlorine forming common salt.

The composition of the leaves and leaf-sheaths is as follows:

Silica		35·900
Coal		4·500
Phosphates:		
of iron	2·900	
Lime	3·396	
Magnesia	0·600	
Silicic acid	trace.	
Phosphoric acid	8·704	
		15·600
Carbonate of lime		5·132
Magnesia		2·600
Potash		21·672
Soda		2·292
Sulphuric acid		5·090
Carbonic acid		0·500
Organic acids		2·400
		103·535 S.

RYE FROM ARBOR HILL, ALBANY (Growth large).

Analysis of the ripe straw, which was divided into two parts between the third and fourth nodes or joints.

	Top.	Bottom.
Silica	70·700	28·250
Phosphate of peroxide of iron	0·250	1·350
Lime	7·304	8·489
Magnesia	trace.	0·050
Silicic acid	trace.	trace.
Phosphoric acid	7·296	5·711
Lime	2·849	1·410
Magnesia	0·300	2·600
Potash	3·732	28·402
Soda	1·324	17·615
Chloride of sodium	1·716	0·489
Sulphuric acid	0·343	1·546
Organic acids	1·305	4·500
	97·118 S.	98·412 S.

There will be removed, in a ton of straw, the following amount of mineral matter in pounds:

	Top.	Bottom.
Silica	56·560	14·803
Phosphates	11·880	8·169
Lime	2·279	0·738
Magnesia	0·240	1·362
Potash	2·985	14·882
Soda	1·059	9·230
Chloride of sodium	1·372	0·256
Sulphuric acid	0·274	0·810
Organic acids	1·044	2·358

It is not forgotten, however, that it is a common practice to return a large part of the straw to the field again: it is not therefore lost. But in the vicinity of large towns, the straw is generaly sold in bundles for various purposes.

The composition of the ripe leaves and leaf-sheaths is as follows:

		Removed in a ton.
Silica	71·650	85·980 lbs.
Phosphates (14·250):		
Phosphate of peroxide of iron	0·250	0·300
Lime	8·658	10·389
Magnesia	trace.	
Silicic acid	trace.	
Phosphoric acid	5·342	6·410
Carbonate of lime	0·817	1·000
Magnesia	0·500	0·600
Potash	2·720	3·264
Soda	3·333	3·999
Chloride of sodium	1·184	1·420
Sulphuric acid	0·100	0·120
Carbonic acid	trace.	
Organic matter	2·650	3·180
	97·204 S.	116·662

Analysis of the ripe chaff of the rye of Arbor Hill.

Silica	85·600
Phosphates (4·60):	
Phosphate of peroxide of iron	0·350
Lime	3·078
Magnesia	trace.
Silicic acid	trace.
Phosphoric acid	1·182
Carbonate of lime	1·664
Magnesia	0·500
Potash	3·922
Soda	1·994
Chloride of sodium	0·245
Sulphuric acid	0·206
Carbonic acid	trace.
Organic acids	1·150
	99·891 S.

Analysis of the ripe grain of the same rye.

Silica	3·450
Phosphates (48·85):	
Phosphate of peroxide of iron	6·350
Lime	6·458
Magnesia	0·816
Silicic acid	0·250
Phosporic acid and phosphates of soda and potash,	34·676
Carbonate of lime	0·282
Magnesia	0·400
Potash	18·217
Soda	8·931
Chloride of sodium	0·709
Sulphuric acid	4·724
Carbonic acid	trace.
Organic acids	6·125
Phosphates of soda and potash	6·600
	97·990 S.

A bushel of rye, weighing 60 lbs., will contain the above elements as follows:

	In a bushel.	In the produce of one acre, at 20 bushels.
Silica	0·331 oz.	0·414 lbs.
Phosphates	4·660	5·826
Lime	0·027	0·033
Magnesia	0·038	0·048
Potash	1·748	2·186
Soda	0·857	1·071
Chloride of sodium	0·068	0·085
Sulphuric acid	0·453	0·566
Organic acids	0·588	0·735
Phosphates of soda and potash	0·633	0·732
	9·403 oz.	11·756 lbs.

ORGANIC ANALYSIS OF RYE.

Raised near Hoosic Falls, Rensselaer county. Full bearing.

Specific gravity - - - - - - 1·282.

PROPORTIONS.	
Per centum of water - - - - -	22·400
" dry matter - - - -	87·600
" ash - - - - -	1·030
" ash calculated dry - - -	1·175
" organic matter calculated dry -	98·825 S.

		Calculated dry.
Starch - - - - - - - - -	53·93	60·737
When dry, translucent, horny; fracture vitreous.		
Dextrine - - - - - - - -	2·10	2·367
Albumen - - - - - - - -	2·51	2·828
Casein - - - - - - - -	0·40	0·450
Matter dissolved out of epidermis and other bodies insoluble in water, by boiling alcohol : it resembles gluten - - - - - - -	1·17	1·318
Matter dissolved out of kernels by digesting them for some time in boiling ether : mostly oil -	6·58	7·415
It has a slight empyreumatic taste, with an odor of warm rye flour.		
Matter dissolved out of epidermis and other bodies insoluble in water and boiling alcohol, by a weak solution of caustic potash : albumen - -	2·34	2·636
Epidermis, after treating it with boiling alcohol and a weak solution of potash - - - - -	11·44	12·890
Water - - - - - - - - - -	12·40	
Extractive matter, sugar, and other bodies not determined : has a pungent, slightly bitter taste	8·28	9·329
	101·15 S.	100·000

Diseases of rye.

Rye is a hardy plant, and resists the attacks of disease and insects to a great extent. A fungous plant, or a degeneration of the kernel, well known as *ergot*, is, however, common to almost every field of rye, but some seasons favor its production more than others.

Various opinions have been expressed of the substance, known as ergot. Some writers maintain that it is a distinct plant; others, that it is a degeneration of the rye kernel. Corda, who is probably the best authority, maintains that the tissues of the kernel are crowded out, and replaced by those of the ergot, and hence that it is a plant.

The structure of this remarkable plant is exhibited on Plate LVI, figs. 21, 22, 23, etc.* Figs. 21 and 22 represent the spurred rye in its natural size. Fig. 24 is the top of a spurred rye-kernel, greatly magnified so as to show the spores *a* and *b; c* the outer skin, and *d* the substance of the plant. Other figures exhibit the structure of the rye-kernel : fig. 28, a thin section of a magnified kernel; *a*, skin or cuticle; *b*, inner seed-skin; *c*, cellular layers of gluten; *d*, albuminous substance, formed from the cells that bear the starch meal. Fig. 29, a cell of albuminous substance, with grains of amylum magnified. Fig. 30, single grains of amylum magnified.

Another fungus, of rare occurrence however, appears upon rye which is grown in elevated positions, or near the borders of rye culture. It is a deep red gelatinous mass, often half an inch in length. It attacks the outer skin of rye-kernels and seeds of grasses, which appear swollen and deformed. The outer skin is wholly destroyed, but the albuminous matter remains unaffected by it (Figs. 16, 17, 18, Pl. LIV). The fungus itself, as seen under the microscope, is a confused reddish white layer, bearing the spores, fig. 19. The cells of the layer form on their tops, spindle-shaped spores or seeds with four cells. This fungus is not poisonous, like that of ergot.

Figs. 16, 17, 18, single degenerated seeds of rye, affected by fungus of the natural size. Fig. 19, a thin section magnified : *a*, fleshy bearer; *c*, spores. Fig. 20, single spores magnified.

III. BARLEY.

Barley, which, in the appearance of its flour resembles wheat, but is quite different in composition, is susceptible of a wider cultivation than wheat. Hence in those districts where wheat, from some cause or other, becomes an unprofitable crop, barley is often substituted for it, and even becomes an advantageous substitute. Its range of culture is very wide, and its liability to a failure is certainly much less than that of wheat.

The barley which I have analyzed, has been derived from only three districts : the Hudson-river, the Southern, and the Western districts. It has not received so much attention as it deserves, for the reason that sufficient time could not be bestowed upon it.

I shall first take up the barley of the Western district. It was furnished by Mr. Peters, of Genesee county, who is one of the most distinguished agriculturists of Western New-York. It was the two-rowed variety, and was well filled. The general characters of the soil have been alluded to, but its particular characteristics have not been given : neither is the mode of culture known.

* Plates and figures from Corda's work, translated from the German by E. Goodrich Smith.

I. BARLEY FURNISHED BY Mr. PETERS.

Straw bright; 18 to 24 inches long.

Specific gravity - - - - - - - 1·176.

	PROPORTIONS.	Actual quantities.
Grain - - - - - - -		1046·70
Straw - - - - - - -		800·00
Chaff - - - - - - - -		236·00

		Water.	Ash.
Grain - - - - - -	100	12·16	3·20
Straw - - - - - -	100		4·04
Chaff - - - - - -	100		5·46

	Silica.	Phosphates.
The ash of 100 grs. of grain gave - - -	0·37	1·43
" " straw " - - -	2·37	1·40
" " chaff " - - -	3·38	0·75

1. *Analysis of the ash.*

		Per centum: without carbonic acid or organic matter.
Silica - - - - - - -	91·800	22·532
Phosphates of lime, magnesia and iron -	31·800	36·188
Carbonate of lime - - - - -	9·500	0·569
Magnesia - - - - - -	1·440	1·638
Potash - - - - - - -	22·770	25·912
Soda - - - - - - -	2·480	2·822
Chlorine - - - - - -	1·030	1·172
Sulphuric acid - - - - -	8·314	9·461
Organic matter - - - - -	5·413	
Coal - - - - - - -	3·531	
Carbonic acid - - - - -	3·141	
	100·219	100·294

2. *Composition of the straw.*

		Per centum: without carbonic acid or organic matter.
Silica - - - - - - -	53·120	57·741
Phosphates - - - - - -	14·500	15·761
Carbonate of lime - - - - -	1·000	1·087
Magnesia - - - - - -	0·160	0·173
Potash - - - - - - -	4·300	4·674
Soda - - - - - - -	5·020	5·456
Sulphuric acid - - - - -	11·700	12·717
Chlorine - - - - - -	2·460	2·676
Carbonic acid and organic matter -	8·113	
	100·373	100·283

3. *Composition of the chaff.*

Silica	65·360
Phosphate	13·260
Carbonate of lime	4·200
Magnesia	0·512
Potash	4·740
Soda	3·751
Chlorine	1·210
Sulphuric acid	8·967
Organic matter	4·268

II. BARLEY RAISED IN ALBANY COUNTY.

Harvested July 25.

Pl. LVII, Fig. 1, two-rowed barley; fig. 2, four-rowed barley; fig. 3, smut; fig. 4, spores.

PROPORTIONS.

145·50 grs. of the grain gave

	Per centum.
Water	63·90	43·90
Ash	5·25	3·60
Ash calculated dry	9·46	

100 grs. of the straw gave

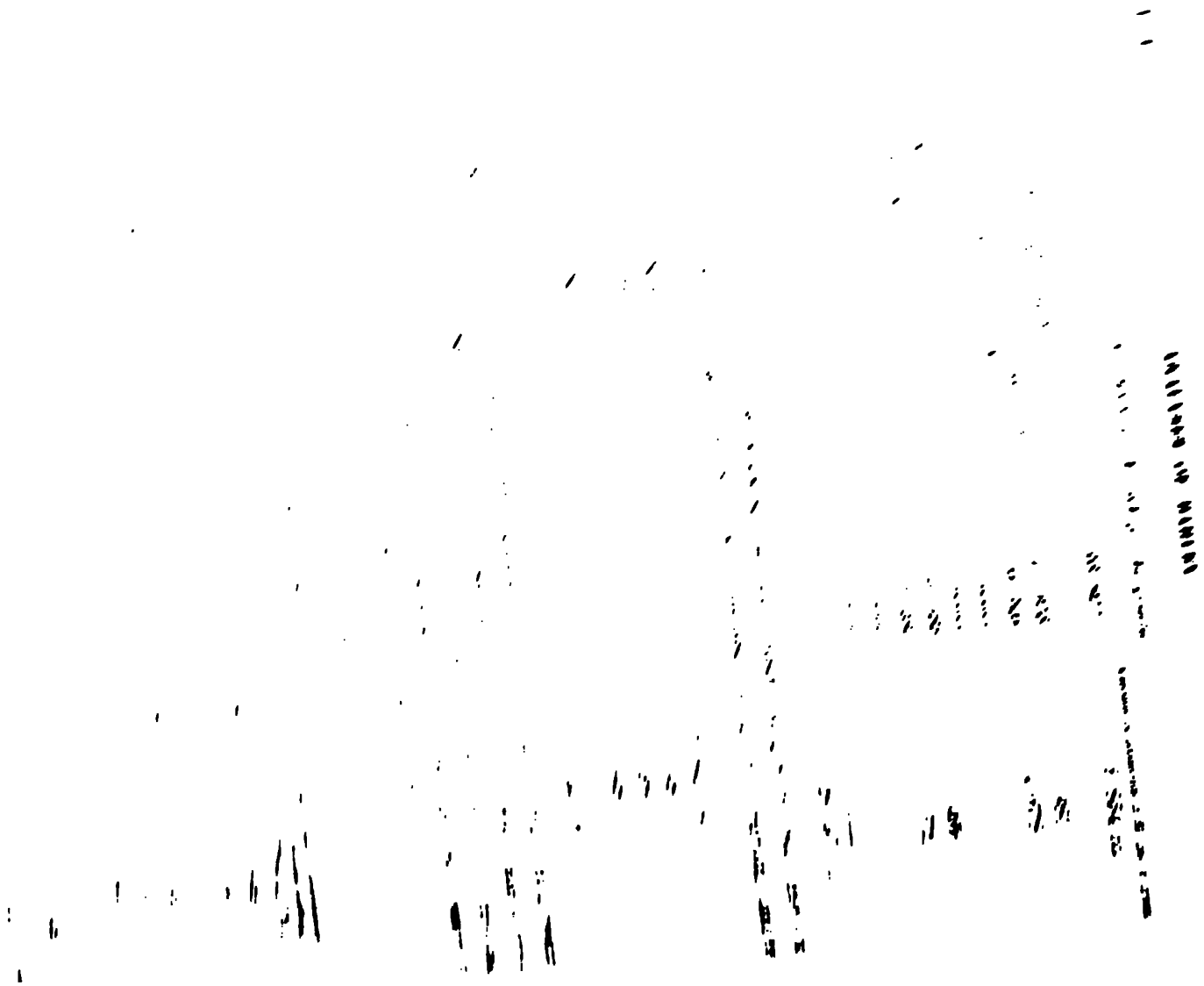
Dry matter	49·500
Ash	2·375

Specific gravity 1·234.

The specific gravity of this barley, although the same variety, the two-rowed, is greater than that grown in Western New-York in the Wheat district. The plant seemed to be of a larger growth, having a length of straw 3 feet.

1. *Comparative proportion of grain to straw, etc.*

	Actual quantities.	Per centum.
Grain	666·00	100·00
Straw	732·00	109·90
Chaff	124·00	18·61



I remarked, in the foregoing paragraph, that this sample of grain gave a result somewhat different from that of barley grown in Western New-York. It will be observed, also, that the straw is different, having less lime, magnesia and chlorine. This straw differs also from a sample received from Col. H. S. RANDALL, of Cortland county.

III. BARLEY RECEIVED FROM COL. H. S. RANDALL.

Raised in Cortlandville, Cortland county. Rock of the county, shales of the Ithaca group, greenish gray, and subject to decomposition; surface undulating; beds of northern drift not unfrequent.

	PROPORTIONS.		
	Actual quantities.	Ash.	Percentage of ash.
Grain	344·31	10·66	3·096
Chaff	62·18	3·50	5·628
Straw	210·00	7·05	3·357

Analysis of the straw.

Silica	37·800
Phosphates (25·0):	
Phosphate of peroxide of iron	12·500
Lime	12·150
Magnesia	0·300
Carbonate of lime	11·900
Magnesia	4·950
Potash	8·505
Soda	none.
Chlorine	trace.
Sulphuric acid	5·312
Organic matter	4·630
	99·097 B.

The lime and magnesia, in this sample of barley, exceed considerably that of Judge PETERS, which was grown upon the shales of the Onondaga-salt group, in which the amount of lime exceeds that either of the Hudson-river district, or the higher range of soils from the slates and shales of the Hamilton and Chemung groups in the southern tier of counties. I have not been furnished, in either case, with the mode of culture, or the manures which were used; facts which, perhaps, would throw some light upon the cause of the differences in composition of the three samples of barley.

IV. ANALYSIS FOR OBTAINING THE PROXIMATE ELEMENTS OF BARLEY.

The method pursued was the mechanical one, by which, from its imperfections, it is impossible probably to represent the true composition. This objection, however, bears with greater force upon the separation of the starch and products representing the gluten. raised and furnished by Judge PETERS, of Genesee county.

341·10 grs. of the grain gave

Fine flour	285·50
Bran	55·60

100 grs. of this flour gave

Starch	54·02
Gluten	1·98
Albumen	1·67
Oil	0·64
Casein	2·44
Dextrine	5·44
Sugar and extract	8·19
A substance insoluble in water or alcohol	18·79

In regard to the foregoing analysis, I have reason to suppose that the oil exists in a larger proportion than that which I have given. It is, however, much like that of maize, of a fine yellow, and a smell not unlike that of cakes taken recently from the oven. After the starch is separated, there remains a brown brittle mass unlike the adhesive gluten of wheat, but from which alchohol dissolved out nearly 2 grains, or ten per cent. The small quantity of gluten renders barley flour unsuitable for bread; that is, light bread, as there is not a sufficient quantity of gluten present to give a permanent consistency to the dough. This brittle substance, or substance without cohesion, might with propriety receive a distinct name, when its composition has been determined. The dextrine forms quite a large proportion, when compared with other grains.

TWO-ROWED BARLEY GROWN NEAR ALBANY.

Harvested July 25.

275·59 grs. gave of

Fine flour	218·30
Bran	57·29

100 grs. of the flour contained

Starch	40·420
Albumen	3·970
Casein	2·080
Matter insoluble in water or alcohol	21·500
Gluten	2·480
Dextrine	7·720
Oil	2·340
Extract and sugar	6·920
Water	13·220
	87·430

Diseases of barley.

There is a strong resemblance, in some of the diseases of the barley, to those of rye. Barley, for example, bears the ergot, which can not be distinguished from that which infests rye. Another diseased growth resembles the smut which appears upon the oat, and is called *barley brand* (*Uredo hordei*). It has its seat in the ears of barley, particularly the floral parts. The effect of the barley brand upon the kernel, is quite different from that upon the oat or wheat. In these, the fruit is wholly obliterated. In the barley, there is developed new woody tissues, or woody bundles; these are formed between the layers of the brand, or fungous plant (See Pl. LVI, fig. 7, *d*, *d*). Fig. 3, *a*, *a*, exhibits the structure of a sound kernel highly magnified, in a section cut across it near its middle. Fig. 6 is a cross section of a kernel attacked with the disease: the outer skin remains sound; but the interior is filled with a mass of black substance intersected with white lines or veins. The spores form a dark smutty mass, inclining to an olive green: they are oval bodies. The spores ripen early, and are shed before the grain is harvested. Those diseased heads, therefore, ought to be removed and burnt, that they may not infest the succeeding crops.

The barley brand, like all others of the same class, is more frequent in cool moist seasons, and on wet soil. It is also much more common in fields sown to barley, when the grain has not been thoroughly cleansed. Fig. 8, Pl. LVI, shows the spores, or reproductive bodies, greatly magnified.

In order to present as perfect a view of the value of the barley as possible, I have copied an article from a late number of the Journal of Agriculture and Transactions of the Highland and Agricultural Society of Scotland, containing two analyses of the brewers' grains so much in use in this country for feeding stock, particularly milch-cows.

Of the composition of brewers' draff or grains, and its value as a food for milk-cows.

A difference of opinion having arisen between the buyers and sellers of brewers' draff in Edinburgh, regarding its value, and the price that ought to be paid for it, Mr. Girdwood thought that some light might be thrown upon this question by a chemical analysis. He caused some of it, therefore, to be sent to the laboratory, where it was submitted to both an organic and an inorganic analysis, with the following results:

1. *Organic analysis.*

A hundred pounds of the fresh draff were found to contain

Water - - - - - - - - - - - -	76·85
Gum - - - - - - - - - - - -	1·06
Other organic matter (chiefly husk) - - - - -	21·28
Organic matter, containing nitrogen (proteine compounds) -	0·62
Inorganic matter or ash - - - - - - - -	1·19
	100·00

From the above analysis we see that, during the digestion of the malt in the mash-tub, the proteine compounds—those which contain nitrogen, and are necessary to the production of muscle in the body, and curd in the milk—are nearly all dissolved out.

2. *Inorganic analysis.*

The ash left on burning the draff was found to consist of

	Per cent of ash.	In 1000 parts of wet draff.	In 1000 parts of dry draff.
Alkaline salts (chlorides, with a small quantity of sulphates) and alkali - - - -	7·60	0·90	3·72
Phosphoric acid in combination with the alkali -	2·11	0·25	1·04
Earthy phosphates - - - - - - -	48·00	5·81	24·06
Silica - - - - - - - - - -	41·51	4·94	20·46
	99·22	11·90	49·28

An examination of the above numbers suggests the following remarks in regard to the value of draff in comparison with other kinds of food.

a. The quantity of water present in it is 76 per cent; in this respect it approaches very near to potatoes, and some other varieties of green food. It contains, however, considerably less than the turnip or the cabbage.

b. The greater part of the solid matter, as we should suppose, consists of husk. This is not wholly insoluble in the stomach of the cow, nor without considerable nutritive power. It is impossible, from theoretical considerations, to assign any definite value to this husk; but the experience of the cowfeeder seems to show that it is not by any means worthless in the feeding of milk-cows. In the grains of the brewers it is generally understood that the proportion of nutritive matter left is much less than in those of the distiller.

c. One important result is the small proportion of proteine compounds, amounting only to two and a half per cent in the dry grains. No doubt this proportion will vary in different samples. It is probably attached to the husk in the form of coagulated albumen, which, however, is dissolved and appropriated in the stomach of the animal.

The draff weighs about 46 lbs. to the bushel, and costs 3d. to 3½d. for this weight. One hundred and sixty pounds of draff contain one of albumen, and this weight costs 1s. Five

pounds of oil-cake contain one of albumen or other proteine compounds, and costs 5d. This ingredient of the food, therefore, is cheaper in the form of oil-cake than in that of brewers' draff.

d. Again, the quantity of ash left by the dry draff is about five per cent. One hundred pounds in the wet state contain 0.6 lbs. of phosphates; or 160 lbs., costing 1s., contain 1 lb. of phosphates. But 33 lbs. of oil-cake contain 1 lb. of phosphates at a cost of nearly 3s.; thus the phosphates are cheaper in the form of draff.

Hence a mixture of other food, such as oil-cake or beans, along with it, is recommended where the draff is to be used most economically and with least waste.

e. A part of the feeding value found in the draff by past experience, is probably to be ascribed to the steeping it has undergone, rendering the otherwise innutritive or slowly nutritious matter soluble in the stomach, and thus admitting of less waste.

Turnips are the kind of food most usually given with brewers' grains. The following letter from Mr. Caird, Baldoon, near Wigton, shows the profit of feeding milk-cows upon draff and turnips, compared with beans and turnips, according to his experience.

"I have fed for the last two winters a large dairy stock in the following manner, for between 6 and 7 months, or 200 days:

Each cow half a bushel of draff (23 lbs.) per day, for 200 days, 100 bushels at 3d.	£1	5	0
Each cow (22 lbs. per day), 2 tons of turnips, at 10s.	1	0	0
	£2	5	0

"And the dairyman to whom my cows are let prefers this feeding to the following, which is the usual allowance in this district to a dairy stock:

Each cow 4 tons of turnips at 10s.	£2	0	0
" 2 bushels of beans, ground, at 4s. 6d.	0	9	0
	£2	9	0

In both cases the same fodder is given.

"On the draff and turnips the cows give fully more milk and butter, both of which are well tasted, and they keep themselves in better condition than when fed on turnips alone. With this feeding they are a very healthy stock.

"On the turnips and beans, the butter and milk are always strong tasted, and the cows are not kept in such high condition as on the draff and turnips.

"If cows get an unlimited supply of turnips, they may yield more milk than on the quantity of draff and turnips mentioned above. They do not eat beyond a certain quantity of draff, while it is difficult to satisfy their appetite for turnips.

"The question as to which of the two is the cheapest food, depends altogether on the respective money values of draff and turnips in any given locality."

IV. MILLET.

This grain is rarely cultivated, so far as my observation extends; and I am informed that it is not held in as much esteem now as formerly. There are probably good reasons why its cultivation is not regarded with favor, but I am not able to assign sufficient causes why it should be neglected. Its analysis, it is true, shows that it is an exhausting crop; but an exhausting crop is also relatively valuable. Its growth is large; and it is highly probable that when left in the field for fodder, the stalks and leaves lose their value. If cut when in blossom, its fodder is valuable, but its seed valueless, and it is then no better than the common grasses. The grain of millet is useless as flour for bread, where maize, rye and wheat, and barley, can be obtained. Its flour, if it has any, is rather coarse, and brownish yellow, or the color of the seed. Millet seed, however, is rich in nutritive elements, and I believe exceeds all others. It is productive: an acre, when properly tilled, yields seventy bushels. In addition to this, the stalk, though not as valuable as timothy, still is equal to oat straw for fodder, and probably superior to it. It requires a rich soil, or at least produces in proportion to its richness.

The specimens for analysis were furnished by Mr. Bement, who has often raised it, and who entertains a high opinion of it, either as food for cattle when cut young, or for its grain when ripened. The plants were of spontaneous growth in a field of potatoes.

ANALYSIS OF THE MILLET.

PROPORTIONS.

1. *Stalk and leaves.*

	Actual quantities.	
	2670·00 grs. ripe, and slightly wilted, gave	
Dry - - -	1309·00	48·65 per centum.
Ash - - -	99·73	3·73

2. *Millet heads in blossom.*

	260·00 grs. gave	
Dry - - -	167·00	64·23 per centum.
Ash - - -	15·74	6·05

3. *Millet grain.*

	840·000 grs. gave	
Dry - - -	not obtained.	
Ash - - -	28·615	3·40 per centum.

Millet heads, cut while in blossom, gave the following results:

Silica	45·083
Phosphates of lime, magnesia and iron	20·000
Carbonate of lime	0·160
Magnesia	0·130
Potash	4·250
Soda	14·650
Chlorine	trace.
Sulphuric acid	12·390
Organic matter and carbonic acid	3·145
	99·788

The large quantity of soda, compared with potash, is quite remarkable. I have no opportunity for repeating the work for the purpose of confirming or disproving this result. The almost total absence of chlorine where so much soda exists, is also unfrequent.

ANALYSIS OF MILLET SEED OR GRAIN.

Silica	44·294
Phosphates of lime, magnesia and iron	34·555
Carbonate of lime	none.
Magnesia	none.
Potash	7·178
Soda	8.239
Sulphuric acid	trace.
Chlorine	trace
Phosphate of the alkalies	0·620
Organic matter	1·459

From five grains of the ash of millet seed, only a trace of sulphate of barytes was observed. The presence of sulphur is, however, clearly indicated in the organic analysis, though only feebly in the ash analyses; the large quantity of nitrogenous matter proving that it must be present in a larger amount than appears in the inorganic analysis.

ANALYSIS OF THE STRAW OF THE RIPE MILLET.

		Elements in a ton of millet straw.
Silica	53·750	44·908 lbs.
Phosphates of lime, magnesia and iron	18·150	15·164
Carbonate of lime	0·400	0·334
Magnesia	0·430	0·360
Potash	17·395	14·533
Soda	1·525	1·274
Sulphuric acid	2·500	2·088
Chlorine	0·512	0·427
Organic matter		
Carbonic acid	1·056	

The straw, especially that which is thoroughly ripened, is larger, coarser and harsher than any of the grasses used for fodder. It is also quite siliceous, its ash being composed of more than one half of silica.

ANALYSIS OF THE GRAIN FOR THE PROXIMATE ELEMENTS.

100 grs. of the comparatively pure flour gave

Starch	34·840
Albumen	8·225
Casein	4·765
Dextrine	4·080
Gluten and oil	6·240
Insoluble matter in water or alcohol, in part fibre	20·230
Sugar and extract	10·200
Water	11·061

The oil, though not accurately determined, exists in about 2 per centum.

The analysis for the proximate elements shows that millet is one of the most nutritive grains we have. The albumen and casein exist in three times the amount they are found in the oat; the gluten in about the same, and oil a little less.

Whether the nutritive elements in these large proportions will recommend this grain to a more favorable notice of the agriculturists of New-York, is a question of some importance. For feeding stock, when ground, it can scarcely be doubted that it must be more valuable than maize, especially for working oxen, or for horses. In addition to the nitrogenous substances, it is certainly not deficient in respiratory nor in bone-forming elements, as phosphoric acid, and lime and magnesia. So in whatever light its composition is regarded, it can not be otherwise than favorable. It is, however, necessary when it is designed for cattle, that it be ground, or made into meal. When it is fed to hogs or canary birds, it may be given whole, or without grinding. Still for the former it must be better when the seeds are crushed, as they are invested with a siliceous cuticle, quite as unfit for digestion as the chaff of other grains.

In order to compare the exhausting power of millet upon the soil, with other grains, it may be stated in this place, that with a yield of 70 bushels to the acre, each weighing 54 lbs., there will be removed,

In Silica	62·451 lbs.
Phosphates	47·310
Potash and soda	19.813

The lime and magnesia is in combination with phosphoric acid; and after the precipitation of the phosphates by ammonia, the filtrate remains nearly undisturbed by the addition of oxalate of ammonia, or phosphate of soda and ammonia. The phosphates, however, unlike those of wheat and indian corn, are tribasic.

Diseases of millet.

Millet is subject to the attack of fungous plants, like rye and other cereals. The smut of millet, inasmuch as it is rarely cultivated, has never fallen under my own observation. It is, however, described by Corda as affecting the whole panicle or head, the original implantation of the fungus taking possession of the whole while invested in the leaf-sheath. The spores are oval, globular, and olive brown. As the whole panicle is infested, and becomes thereby a prominent object, it is easy to destroy or remove the fungus from the field, by removing the infected individuals and burning them; for if suffered to remain in the field, it will propagate itself for a long time afterwards.

For illustrations of the millet smut, see Pl. LVII, fig. 3 – 7, *Uredo destruens*. Fig. 3, immature brand or smut; 4, mature, and shedding its spores; 5, single fibres, natural size; 6, magnified: *a*, cells of the inner bark; *b*, spiral vessels of the woody bundles; 7, spores strongly magnified.

V. WHEAT.

It is unnecessary to speak of the importance of this grain: its value is appreciated by community; yet in saying this, we doubt much whether the influence of its culture and use is fully felt by a large portion of society. The doubt is expressed, from the belief that it has had no inconsiderable share of influence on the progress of civilization. It is the food of civilized man. It is the bread of refinement and taste. The loaf of the Genesee flour is the extreme luxury of polished life; while the hoecake of indian corn, baked in ashes, is the symbol of savage fare. The former has become the standard food of the wealthy; while the latter finds its place on his table, rather as a curiosity than one of common resort.

The culture of wheat, too, is a civilized act: it is almost incompatible with savage life. A perfect crop requires the exercise of the highest skill of the husbandman's art: it is the *ne plus ultra* of agriculture. It is true, that thousands of acres wave their heads to the breeze in the west, under the management and culture of ignorance it may be; but it is in a virgin soil, which nature has made, and whose elements are mixed in right proportions to bring forth the crop. But soon this power fails, and, with its failure, the plant is a profitless product, until knowledge and art restore it to its standard value.

In the present state of society, the place of wheat could not be compensated by either of the other cereals. None of them are really fitted for use alone; while wheat is so constituted, that a mixture of the flour of any other grain is not required either for bread or pastry: it is fit in itself for the purposes for which bread, in its widest meaning, is required.

The history of the wheat, then, is in part the history of the progress of nations in civilization. It has kept pace with this progress, and has had its influence in promoting it.

The wheat culture of New-York has always held a high place in its husbandry. It is eclipsed, perhaps, by that of many of the western States in their early settlement; but for real adaptation, both in soil and climate, a large portion of New-York is not excelled. It is not to be concealed, however, that the means of communication over wide areas have been so far increased in the last twenty years, that the profits of the crop in this State have apparently diminished. This fact has undoubtedly had its influence upon the extent of its cultivation; still it is among the first in the amount of its productions, and undoubtedly it ever will continue a leading and prominent grain in its husbandry.

Wheat seems to be easily influenced by soil and climate. To this cause, we are indebted for many varieties which possess peculiar characters, or in which there is an excess of one of the proximate elements over the others. Gluten, the pasty part of the grain, is largely developed in some, and starch in other varieties. Some are protected by a thick cuticle, which forms the bran; in others, it is thin and delicate. The former are dark colored usually; the latter, white. Some again are armed with stiff and rigid awns; others are awnless. Silex is more abundant in some than in others. Those in which this element is in full proportion, stand erect, and never lodge. Even in the course of a few years' culture, changes occur in the constitution of wheat, which are easily observed. Thus the Mediterranean wheat, which has the property of hardiness to recommend it, and which has a thick skin and dark color, becomes assimilated in a few years to the more delicate and whiter varieties. This is especially the case in Central New-York; and from this fact, alone, we might draw the inference that Central New-York is the true land for the cultivation of the finest varieties of this grain.

I have supposed that farmers will be interested in making a thorough acquaintance with the varieties of wheat which have been in culture in this State. I have therefore prepared drawings of several of the most important kinds, whether they have succeeded or failed, whether they were worthy or unworthy of cultivation. The facts upon this branch of the subject I have derived from farmers of experience, and particularly from Rawson Harmon, esquire, of Monroe county.

A. WINTER WHEAT.

1. *White Flint.* In this State it is an esteemed variety, and is supposed to be of Spanish origin. It has been cultivated here about thirty years. Its color is white, and the awns of the chaff are soft, and confined to the upper part of the head. The straw is of a medium length, and is quite solid and wiry at the root, and hence is not liable to lodge. The heads are only of a medium length, but they are well filled out with white thin-skinned kernels, which strongly adhere to the spike. The straw too is white and clean, with only a few leaves. This quality, the adherence of the kernel, which was once an

objection when flails were in use, has become a recommendation since threshing machines have been introduced. This variety has a specific gravity* 1·312.

This variety has other recommendations : It succeeds in loam soils, bears the frost well, and resists the attacks of the fly. The kernel, from its hardness, or siliceous cuticle, is less injured by fall rains than many other varieties; and hence, too, it may stand in the shock with very little danger of growing. It is still disposed to vegetate soon after sowing, and hence may be ranked with the hardy and vigorous kinds.

2. *Improved White Flint Wheat.* This variety resembles very closely the preceding. It is considered by Mr. HARMON as new; having been produced by himself, by a selection of the best seed, and liming and sowing it upon a limestone soil. It is larger than the White Flint; and yet the cuticle of the kernel is equally thin, delicate and white. It weighs, according to the statement of Mr. HARMON, when prepared for seed, 64 lbs. to the bushel. The specimen in the Agricultural Society's collection has a specific gravity of 1·310, and was furnished by the improver of the White Flint, and hence may be regarded as authentic. The specific gravity, however, is rather less than I should have expected from the weight per bushel. Two bushels and eighteen pounds of this wheat produced 106·8 lbs. flour and 31 lbs. of bran : loss ½ lb., equalling in the whole 138 lbs.

3. *White Provence Wheat* (Pl. XXVIII, fig. 7). This is a French variety, and is regarded as one of the finest kinds of wheat. It is without beards, and has a large white kernel with a thin skin. It grows rapidly, has larger blades, and sends out a greater number of straws from a root than most varieties. The straw, however, is weak, and does not support itself well. Specific gravity, 1·297. From its low specific gravity, I infer that it weighs less to the bushel than the White and Improved Flints. Specimens in the Society's collections.

4. *Old Red-chaff Wheat.* The Old Red-chaff has been cultivated nearly half a century. It has been one of the most esteemed kinds under cultivation in this State. It is free from a beard or awns; has a long straw and slightly brown head, which arises from the color of the chaff : its flour is, however, white. It weighs from 60 to 63 lbs. to the bushel. Specific gravity, 1·313. It stands up well; but of late, it is remarked by Mr. HARMON, that it has suffered from rust and mildew, and has been injured by frosts or winterkills especially on old lands.

5. *Kentucky White-bearded, Canada Flint, Hutchinson Wheat.* In Western New-York, it has become a favorite variety. It is considered as less valuable than the White Flint, by Mr. HARMON. The bran, he says, is thicker. It spreads but little, and therefore requires more seed. This, however, can not be regarded as an objection to the wheat. Its

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* The true weight of wheat is determined by its specific gravity. The weight of a bushel of wheat will vary with the size of the kernel, and from other circumstances; while its relative weight, or that found by comparing it with an equal bulk of water at a given temperature, depends upon its composition. The heavy varieties, or those with a high specific gravity, contain more gluten than the light : the latter contain the most starch.

straw is strong; and hence, on rich loamy lands, it will succeed better than those with a weaker straw. The straw too having more substance, the grain matures or fills out after it has been cut.

6. *Indiana Wheat* (Pl. XXVIII, fig. 12). It was introduced from Indiana. It is awnless, with a large white kernel; cuticle thin; weight per bushel, 64 pounds. It ripens a few days earlier than the White Flint, but it shells out easily when ripe. It has yielded 33 bushels to the acre, and is adapted to strong soils. Specific gravity, 1·334.

7. *Velvet-beard* or *Crate Wheat* (Pl. XXVII, fig. 12). It has been cultivated about twenty years in Western New-York. It has long awns, a red chaff and kernel. It requires a strong soil; weighs from 60 to 64 lbs. to the bushel; flour yellowish. It is said to be inferior to many of the varieties now cultivated in New-York.

8. *Soule's Wheat* (Pl. XXVIII, fig. 9). Mr. HARMON regards this variety as one made of the Old Red-chaff and White-chaff, bald. It is spoken of as an excellent kind; and in some parts of Western New-York, it is the kind most esteemed. Its kernels are large and white, and yield a superior white flour. Specific gravity, 1·333.

9. *Virginia White May Wheat* (Pl. XXVII, fig. 2). It resembles the White Flint. It appears to have deteriorated by culture in New-York. It ripens six or eight days earlier than the White Flint, and has not been injured by rust.

10. *Wheatland Red Wheat* (Pl. XXVIII, fig. 3). This is another variety which has been brought out by the skill of Mr. HARMON, from the preceding kind. Its chaff is red; head bald, and of a medium length. It is said to weigh 66 lbs. to the bushel. Its specific gravity is 1·321. The objection to this kind is its red berry: its recommendation is that it does not rust.

11. *Tuscan Bald Wheat.* This kind, which was introduced from Tuscany in 1837, has been laid aside in consequence of its liability to be injured or destroyed by frost. Its flour is fine and white, and its heads well filled.

12. *Mediterranean Wheat.* The recommendations which this kind bears, are, that it is early, heavy, and escapes all disasters, the fly not excepted. It is objectionable from its dark color and inferior flour. It is heavy, having a specific gravity of 1·360. It is bearded; shells very easily, if it is suffered to stand until it is ripe. It is not cultivated in Western New-York, where the better kinds succeed well.

13. *Valparaiso Wheat* (Pl. XXVIII, fig. 4). Introduced from Valparaiso. Without awns; seed white, cuticle thin, and resembles the White Flint.

14. *Skinner Wheat.* With awns; chaff white; straw short and stiff; weight 64 lbs. to the bushel. It is not in so much esteem as to displace other kinds.

15. *Golden-drop Wheat.* Awnless, with a red chaff and rather thick cuticle. It is inferior to other well known kinds in Western New-York.

16. *White Blue-straw Wheat.* This kind has been received from Maryland, at the Society's room. It is a beautiful kind, and yields a white and fine flour. Specific gravity, 1·344; with the cuticle removed, 1·379. It is worthy of observation that the specific gravity is increased by the removal of the cuticle.

17. *Aguira Wheat.* This kind was brought, two or three years since, from Spain, by F. TOWNSEND, esquire, of Albany. It is a very beautiful kind, the kernel being large and white. Specific gravity, 1·394. Its weight approximates more closely to the celebrated English kinds, than any of the preceding.

18. *Verplanck Wheat* (Pl. XXIX). In richness of appearance, this wheat excels most others which I have noticed. Its kernel is very large and white; the head long, large, and well filled. The straw is large, and tall in proportion, being at least four and a half feet. The grain, however, is light, as will be seen from its low specific gravity, which only attains 1·261. I am not informed how it is regarded by the wheat-growers of Western New-York.

B. SPRING WHEAT.

1. *Italian Spring Wheat* (Pl. XXVII, fig. 18). This kind, which at first was esteemed, has so far deteriorated as to be neglected.

2. *Tea Wheat, Siberian Wheat* (Pl. XXVII, fig. 3). As a spring wheat, it is regarded as a very good variety; giving a white berry, and fine white flour. It is not subject to rust.

3. *Black-Sea Wheat.* The advantages arising from the culture of this wheat, are, that it escapes the fly, ripens early and rarely mildews. Its disadvantage is that it yields a dark flour of an inferior quality. Its specific gravity is 1·341. In Vermont, Massachusetts and Maine, it is often sown, as it is less liable to a failure than the finer varieties.

4. *Rock Wheat* (Pl. XXVIII, fig. 1). This is a Spanish wheat, and has been cultivated more than forty years. The chaff is white, but the berry is red. Where the finer kinds are uncertain, this has been cultivated with success.

5. *Black-bearded Wheat* (Pl. XXVII, fig. 14). Awns long and stiff; heads heavy; straw large, and berry red and large; hardy.

6. *Red-bearded Wheat.* Awn red, and standing out from the head; kernel white; chaff red. Yields a good flour. A bushel weighs from 60 to 62 pounds. It succeeds best on stiff clay loams. It has yielded 44 bushels to the acre. Its beard is objectionable.

7. *Scotch Wheat* (Pl. XXVIII, fig. 11). Its origin is unknown. Berry large, and resembles the Indiana; straw large.

8. *Egyptian Wheat, California Wheat.* The peculiarities of this kind are, that it has a large branching head, as many as six or seven branches, bearded; berry small, with a thick cuticle or bran. Its flour has a harsh coarse feel and a yellowish color, which resembles that of barley. It has not met with much favor.

9. *Talavera Wheat* (Pl. XXVII, fig. 16). Awnless; chaff white; straw long, white and stiff; heads large, long and well filled. Specific gravity, 1·306. It is not sufficiently hardy to stand severe winters. It is frequently injured by the fly.

Additional varieties of wheat which have been somewhat cultivated in this State.

1. *Velvet-chaff Bald* (Pl. XXVII, fig. 4). Chaff greenish brown and dotted, without beard or awns.

2. *Wheatland Yellow* (Pl. XXVII, fig. 5). Chaff pale yellow, with short awns; heads large and berry large.

3. *Virginia Blue-straw* (Pl. XXVII, fig. 6). Chaff yellowish, without a beard; head small.

4. *Hume's White* (Pl. XXVII, fig. 8). Heads rather long and slender; chaff yellow.

5. *Bearded Baltic* (Pl. XXVII, fig. 7). Heads thick and heavy; chaff yellowish brown, bearded; beards moderately long.

6. *Skinner's Club* (Pl. XXVII, fig. 9). Kernels clustered in whorls; chaff greenish yellow, bearded.

7. *Old Bearded Tuscany*. Kernels clustered, and with long beards, greenish yellow; heads rather long.

8. *Pale Red-chaff* (Pl. XXVII, fig. 11). Kernels thickly clustered; chaff pale brown, beardless; heads rather long.

9. *Baltic Downy* (Pl. XXVII, fig. 13). Chaff brown, quite downy; heads long, beardless.

10. *Old Black Bald* (Pl. XXVII, fig. 14). Kernels irregularly clustered; chaff brown, bearded.

11. *Poland White Bald* (Pl. XXVII, fig. 15). Berry irregularly clustered; chaff greenish yellow, awned, or with shortish beards.

12. *New Velvet-chaff* (Pl. XXVII, fig. 17). Kernels very thickly clustered, bearded.

13. *Black Velvet-chaff* (Pl. XXVIII, fig. 5). Kernels closely set and thick; chaff very dark.

14. *Bald Baltic*. Kernels thickly set in regular rows; chaff light brown; heads thick, heavy.

15. *Old White-flint* (Pl. XXVIII, fig. 10). Kernels clustered; chaff yellow, beardless; heads rather short.

16. *Early Velvet-beard*. Kernels clustered in whorls; heads long and yellow.

17. *Italian Spring Wheat* (Pl. XXVIII, fig. 14). Kernels clustered, irregularly arranged upon the spike; chaff greenish yellow, thickly bearded.

18. *Bearded Valparaiso*. Kernels in rows, regularly arranged; head short and thick, bearded.

19. *Washington Wheat* (Pl. XXIX). Heads very large and long; chaff brown; beards long; berry rather dark, but numerous, amounting to 70 or 80.

20. *Verplanck Wheat*. Heads quite large and beautiful; berry of the largest size.

21. *Club Wheat*, *Pennsylvania Wheat* (Pl. XXIX). Heads short; kernels in regular rows, bearded.

22. *Spring Red-chaff* (Pl. XXIX). Kernels clustered; heads long; chaff reddish brown, bearded.

23. *Spring Wintington Wheat* (Pl. XXIX). Kernels thickly set, but irregular and large; chaff yellow, bearded.

ANALYSIS OF WHEAT, INCLUDING ITS STRAW AND CHAFF.

Many difficulties exist in the analysis of the grain of the cereals, and particularly in wheat and indian corn. In consequence of this fact in part, I regret that I am unable to give a full account of the composition of the former. But this is not all. I have been poorly supplied with samples of the grain; and not living in a wheat district, I have been unable to procure it, either in a ripe condition, or in its different stages of growth. I made repeated applications, both to the members of the Agricultural Society, and to other individuals, but only in two or three instances have my applications been successful. I availed myself, however, of several fine samples of wheat in the Society's Collection, which were furnished by Mr. HARMON, who has been referred to already. These, although the straw was in sufficient quantity for analysis, the grain itself was insufficient in amount to answer well that object. I have, however, made as good a use of the means within my reach, as I was able; and I propose now to enter upon the details, as far as I am able at the present time, expecting that farther time and opportunity may be given to extend my examinations of this important subject, the results of which will in that case appear at the close of the volume.

I. WINTER WHEAT FROM GENESEE COUNTY.

Received from Mr. PETERS. The variety not given.

Specific gravity	1·289
PROPORTIONS.	
GRAIN	100·000
Ash	1·450
STRAW	100·000
Ash	2·660
CHAFF	100·000
Ash	7·970

From these proportions, I obtained from the ash of the grain,

Silica	0·075
Phosphates	0·810

From the straw,

Silica	1·285
Phosphates	0·070

From the chaff,

Silica	6·435
Phosphates	0·080

The phosphates were obtained by precipitation by caustic ammonia, and hence the full amount of phosphoric acid does not appear in the grain.

1. *Analysis of the ash of* Mr. PETERS's *winter wheat.*

Effervesces slightly on the addition of acid.

Sand	3·525
Silicic acid	1·700
Phosphoric acid with part of the magnesia	60·725
Lime	0·050
Magnesia	2·880
Potash	7·180
Soda	16·920
Sodium	0·195
Chlorine	0·295
Sulphuric acid	0·895
Organic acids	2·400
Carbonic acid not determined.	
	96·775 S.

2. *Organic analysis.*

100 grs. gave as follows:

Starch	61·400
Albumen	1·215
Gluten	4·460
Casein	trace.
Matter dissolved out of epidermis and other bodies insoluble in water and alcohol, by acetic acid	1·980
Matter dissolved out of epidermis and other bodies insoluble in water, alcohol and acetic acid, by a weak solution of caustic potash: comports itself like albumen	1·480
Epidermis after digesting in alcohol, acetic acid and potash	3·410
Dextrine	2·400
Water	9·380
Oil	1·050
Extractive matter and sugar, and loss	13·225
	100·000 S.

This analysis is not complete: the extractive matter and sugar were not obtained.

PROPORTIONS.

Water	9·380
Dry matter	90·620
Ash	1·650
Ash calculated on dry matter	1·821 S.

II. BLACK-SEA WHEAT FROM LEWIS COUNTY.

Soil slaty, being based upon the Utica slate.

1. *Analysis of the ash.*

		Removed from an acre.
Silica	4·300	0·970 lbs.
Phosphates of lime, magnesia and iron	45·376	10·240
Phosphate of the alkalies	28·195	6·363
Potash	10·830	2·444
Soda	8·110	1·830
Lime	0·010	0·002
Magnesia	0·020	0·004
Organic matter		
Carbonic acid	1·340	0·301
	98·221	22·154

2. *Analysis of the earthy phosphates.*

		Per centum.
Soluble silica	0·003	0·074
Lime	1·940	2·380
Phosphate of peroxide of iron	1·880	4·470
Magnesia	2·920	12·440
Phosphoric acid	12·825	30·760

III. BLACK-SEA WHEAT FROM THE SAME COUNTY.

Specific gravity 1·341. Kernel small, and but little lighter colored than the best kinds of rye. Soil based upon limestone.

Analysis of the ash.

Sand	3·700
Silicic acid	1·550
Phosphoric acid with part of the magnesia	62·075
Lime	0·050
Magnesia	3·435
Potash	8·045
Soda	14·790
Sodium	0·320
Chlorine	0·490
Sulphuric acid	0·340
Organic acids	2·000
Carbonic acid not determined.	
Effervescence very slight on adding acid to ash.	
	96·795 S.

IV. ANALYSIS OF SUMMER WHEAT.

Received from Mr. PETERS of Genesee county.

		Removed from the acre.
Silica	2·633	0·687 lbs.
Sand	1·607	0·419
Phosphates of lime, magnesia and iron	48·000	12·528
Phosphates of the alkalies	19·440	5·073
Lime and magnesia	0·020	0·005
Potash	14·720	3·841
Soda	3·356	0·875
Chlorine	none.	
Sulphuric acid	0·544	0·141
Organic matter	8·480	2·213
	98·864	25·782

Percentage of water of Black-sea Wheat grown on different soils.

On limestone	10·52
On slate	10·72
On alluvial gravel	10·27
On sandy soil	11·10

The variety known as *Harmon Wheat*, grown upon clay loam based upon the rocks of the Salt group, gave water 11·82, after long drying in the water bath. The last had assumed a brown color, and appeared partially charred, although it had never been exposed to a temperature above 212° Fahr.

From the preceding observations, and others of the same kind, I am led to believe that this grain has always in combination about the same quantity of water, and that soil and varieties do not cause it to vary much either way from 12 per centum of water. This amount of water, however, although it is comparatively small, has probably a decided influence upon its preservation in transportation to foreign countries. The hygrometric power of grains and flour has not been determined. The percentage of water may not of itself form an obstacle to its keeping; and if it is not in a situation to imbibe more, it may perhaps remain for years in a sound state.

V. BLACK-SEA WHEAT FROM LEWIS COUNTY.

Grown upon the Trenton limestone.

Analysis of the ash.

Silica and sand	14·520
Earthy phosphates	43·333
Alkaline phosphates	23·646
Potash	12·629
Soda	5·068
Magnesia and lime	0·030
Chlorine	trace.
Sulphuric acid	trace.
Carbonic acid	none.

VI. A WINTER WHEAT FROM THE SAME COUNTY.

Grown upon sandy soil. Variety not given. Furnished by Mr. BEACH.

1. *Analysis of the ash.*

Silica	9·120
Sand and coal	10·000
Earthy phosphates	48·273
Alkaline phosphates	15·501
Potash	23·407
Soda	4·044
Lime	0·020
Magnesia	0·002
Sulphuric acid	trace.
	100·367

2. *Analysis of the earthy phosphates.*

Soluble silica	0·08
Lime	1·98
Phosphate of peroxide of iron	4·95
Magnesia	6·64
Phosphoric acid	28·31

VII. WINTER WHEAT FROM THE SAME COUNTY.

Furnished by Mr. Beach. Grown upon a gravelly soil.

Analysis of the ash.

Silica and coal	12·134
Earthy phosphates	37·072
Alkaline phosphates	21·313
Potash	22·496
Soda	7·348
Chlorine	trace.
Sulphuric acid	trace.
Magnesia and lime	0·031

Note. I was desirous of repeating all those analyses in which so much foreign matte as coal and sand, existed. Experience subsequently enabled me to avoid this objectionabl state of the ash; still, the results are correct for all the elements except silica. In regar to this, I have been satisfied that it varies from 1·50 to 5 per centum; and it is probabl in those varieties grown upon soils of Lewis county, that they reach the maximum pe centage. The grain has a thick cuticle, and is rather dark; and it is in these kinds th the silica is in the largest proportions.

VIII. STRAW AND CHAFF OF WHEAT FROM Mr. PETERS.

1. *Analysis of the straw.*

		Removed in a ton of straw.
Silica	49·100	29·255
Earthy phosphates	19·600	11·678
Lime	3·460	2·061
Magnesia	0·324	0·193
Potash	22·245	13·253
Soda	5·195	3·095
Sulphuric acid	0·876	0·521
Chlorine	0·121	0·072
	100·921	60·128

2. *Analysis of the chaff.*

		Removed in a ton of ch
Silica	80·60	143·893
Earthy phosphates	8·80	15·710
Carbonate of lime	4·70	8·390
Magnesia		
Potash	1·80	3·213
Soda	3·20	5·712
Sulphuric acid	1·21	2·160
Chlorine	trace.	
	100·31	179·078

Proportions of grain, straw and chaff of several varieties of wheat.

	Actual quantities.	Per centum.
1. *Old Red-chaff Wheat*		
Grain	724 grs.	100·000
Chaff	221	30·524
Straw	1154	159·392
2. *Talavera Wheat.*		
Grain	1240	100·000
Chaff	292	23·548
Straw	1444	116·209
3. *Indiana Wheat.*		
Grain	556·50	100·000
Chaff	129·50	23·270
Straw	611·00	109·811
4. *Improved Flint Wheat.*		
Grain	1130	100·000
Chaff	272	24·070
Straw	1323	117·079
5. *Harmon Wheat.*		
Grain	1207·50	100·000
Chaff	300·00	24·844
Straw	1166·50	96·604

To determine the foregoing proportions of grain, etc., I took from a small bundle those heads and straw which remained perfect, a certain number, and shelled the grain, and weighed each part by itself. This method of determining the proportions of grain, chaff and straw, has been found as correct, if not more so, as weighing large quantities in the usual way. Due care must, of course, be taken to avoid losses in separating the grain.

IX. IMPROVED WHITE-FLINT WHEAT.

Analysis of the straw.

Silica	42·60
Carbonate of lime	8·90
Phosphates of lime, magnesia and iron	9·30
Potash	22·76
Soda	5·28
Magnesia	1·58
Sulphuric acid	5·85
Chlorine	1·86
	98·13

X. OLD RED-CHAFF WHEAT.

Analysis of the straw.

		Removed in a ton of straw.
Silica	70·00	78·40 lbs.
Coal	0·25	0·28
Phosphates of lime, magnesia and iron	8·89	9·95
Carbonate of lime	1·80	2·01
Magnesia	0·15	0·16
Potash	12·12	13·57
Soda	4·19	4·69
Sulphuric acid	2·25	2·52
Chlorine	1·75	1·94
	101·50	113·52

The straw of the Old Red-chaff is stiff and rigid; and from its characters alone, it would be inferred that it contained a greater percentage of silex.

XI. WHEATLAND RED WHEAT.

Analysis of the straw.

		Removed in a ton of straw.
Silica	75·75	84·84 lbs.
Phosphates	8·21	9·19
Carbonate of lime	1·05	1·17
Magnesia	0·25	0·28
Potash	7·20	8·06
Soda	2·10	2·35
Chlorine	0·24	0·26
Sulphuric acid	2·21	2·47
	97·01	108·62

XII. SOULE'S WHEAT.

Specimen taken from the State Agricultural Rooms. Fine plump berry.

		Calculated on dry matter.
Starch	62·29	68·360
Sugar and extractive matter, with a little acid formed during the analysis	6·40	7·023
Dextrine or gum	1·21	1·328
Epidermis	7·20	7·903
Matter dissolved out of epidermis and other bodies insoluble in water and boiling alcohol, by a weak solution of caustic potash	6·82	7·485
Oil	1·02	1·119
Gluten	4·51	4·949
Albumen	1·67	1·833
Casein	trace.	trace.
Water	9·79	
	100·91 S.	100·000

The gluten in the above analysis is small, though I think correct. The matter insoluble in water was digested in successive portions of boiling alcohol for six hours, till nothing more was taken up. The matter insoluble in water and boiling alcohol was digested in a weak solution of caustic potash, which took up over 7 per centum of the dry grain ; which, if albumen, increases that body to a large percentage. The gluten and starch agree nearly with the winter wheat from Genesee, but the albumen and epidermis are much greater.

PROPORTIONS.	
Percentage of water	9·790
" dry matter	90·210
" ash	1·720
" ash calculated on dry matter	1·906 S.

XIII. PROVENCE WHEAT.

Analysis of the straw.

Silica	68·60
Phosphates	4·70
Carbonate of lime	2·35
Magnesia	1·35
Potash	5·55
Soda	5·63
Sulphuric acid	2·83
Chlorine	1·34
Organic matter	4·20
Carbonic acid	1·40
	97·95

XIV. HOPETON WHEAT*.

Length of straw, 44 inches.

1. *Relation of grain, straw and chaff.*

	Actual quantities.	Percentage.	
Grain	1207	42·30	
Straw	1423	49·86	57·70
Chaff	224	7·84	

Specific gravity of the grain - - - 1·391

2. *Percentage of water and ash.*

	Water.	Ash.	Ash calculated dry.
Grain	12·5	1·76	2·01
Straw	13·7	4·16	4·82
Chaff	11·5	10·36	11·70

3. *Produce, and mineral matter of an acre.*

	Produce.	Mineral matter.
Grain	22·16	43·5
Straw	25·94	120·4
Chaff	4·11	57·6

4. *Analysis of the ash of the grain.*

		Removed from an acre. lbs.	oz.
Silica	3·20	1	6·6
Phosphoric acid	44·44	19	6.0
Sulphuric acid	trace.		
Carbonic acid	none.		
Lime	8·21	3	9·2
Magnesia	9·27	4	3·3
Peroxide of iron	0·08	0	0·9
Potash	32·14	17	13·8
Soda	2·14	1	8·8
Chloride of sodium	none.		
	99·97	43	9·7

* Journal of the Royal Agricultural Society.

5. Analysis of the straw and chaff.

		Removed from an acre. lbs.	oz.
Silica	67·10	119	6·8
Phosphoric acid	6·05	12	8·7
Sulphuric acid	5·59	91	5·2
Lime	4·44	7	14·4
Magnesia	3·27	5	13·0
Peroxide of iron	1·54	2	11·8
Potash	10·03	17	13·6
Soda	0·85	1	8·6
	99·97	177	11·5

The foregoing extract, exhibiting the proportions of water, grain, composition, etc. of an English variety of wheat, has been copied for the purpose of comparison with wheat of New-York growth. A comparison can be made by any person who feels an interest in the matter. I do not, therefore, propose to enter upon a detail of difference or similarity; observing, however, that in the statement respecting the phosphates and phosphoric acid, I have given the phosphates of the earths and phosphates of the alkalies, by which it will be perceived that the earths, the lime and magnesia, as well as iron, are in combination with phosphoric acid. This fact does not appear in the extract which is given.

The real composition of wheat appears only when an analysis is made of its parts, as bran (which is the cuticle), and its flour. Time, however, has not permitted me to make those analyses. I can therefore make only the following very brief statement:

Shorts, which is mostly a coarse bran, gives
- Ash 5·115 per centum; which contains
- Silica 0·140
- Phosphates of magnesia, lime and iron, 2·380

Fine middlings lost in a water bath 12·78 of water;
- Bran 12·37 water,

which proportions are rather greater than that given by wheat.

The specimen of winter wheat furnished by Mr. PETERS 9·72 water.
- Summer wheat 9·62

Proportion of ash and water in the straw of four varieties of wheat.

		Mineral matter in a ton of straw.
INDIANA, water	8·50	
Ash	4·40	99·90 lbs.
OLD RED-CHAFF, water	7·50	
Ash	5·22	117·60
IMPROVED WHITE-FLINT, water	9·50	
Ash	4·50	160·80
TALAVERA, water	8·00	
Ash	5·46	122·30

DISEASES OF WHEAT.

Wheat or Smut Brand (*Uredo sitophila*, Dittmar). Among all the species of brand which infest our grain crops, this is by far the most worthy of notice. It lodges only in the ears of wheat, and is found in no other kind of grain or grass. It migrates with wheat in all climates of the earth, without being subject to local influences, as is almost ever the case with the other cultivated plants. The farmer dreads it most, and justly; for being lodged in the ears when they are brought to be threshed, it is there dispersed by the flail or threshing machine, and thus directly infects the sound grain; while the barley and oat brands are for the most part out on the field, and hence the largest portion of the seed of these latter kinds of brand necessarily falls on meadow, forest, or other kinds of soil, which are not applied to the cultivation of grain, and so, for the want of plants adapted to the infection, are not further spread.

Those halms of wheat which afterwards bear ears affected with brand, may be early distinguished, before their bloom, by their luxuriant growth and their dark green color, as well as by their large, broad, stiff leaves. They apparently bloom much earlier; but very often (yet not always) their anthers contain no grains of pollen (powder of fructification); and the first act of fructification, the shedding of their pollen on the cup of the pistil, is very imperfect; and should the ears affected by the brand and already diseased be dusted with sound pollen, the little balls of pollen usually form no aggregation of pollen on the pistil, or such as are formed do not press into the pistil and down to the ovary. The fructification of the blossoms of wheat affected by brand is therefore imperfect; and in case the grains of pollen form no cluster in the cup, then there is indeed no fructification; but the careful observer finds on almost all the ears ripe for receiving the grains of brand, on the side of every seed corn affected with brand, one or two anthers (Plate LV, fig. 3, 4, *b*, *b*), which, on the buds which are well fructified and bear seed, the anthers with their stamens have long since fallen off. The anthers which remain standing on the grains affected with brand are usually destitute of pollen; and sometimes we find that the same, in consequence of efforts at imperfect fructification, are stuck, as it were (fig. 4, *b*, right side), to the pistils which remain standing (fig. 4, *c*). The two pistils which remain standing, of the seed affected with brand, are usually covered and joined together by delicate white threads interwoven like mould in a sort of network (Plate LV, fig. 4, *c*). This mould formation belongs essentially to the wheat brand, and forms as it were a part of the root texture of the fungus constituting the brand. It always exists, only frequently more or less developed, and therefore more or less easily found. It wholly covers the head of the seed, and lies between the chaff-hairs (fig. 16, *h*), while the sound seed exhibits not a trace of such an interwoven fibrous formation among the chaff-hairs on its head. The same is also the case in respect to the pistils of the sound seed (fig. 16, *i*). With the development of this outer fibrous mould begins likewise the transformation of the seed, as well in respect to its external form as to its internal structure.

If the transformation which the seed of wheat undergoes by the formation of brand be examined, we find that the particles have undergone either an entire or partial transformation in respect to internal structure; and without here entering on the technological signification of the several parts of the seed, I shall describe the same, in a way generally intelligible, and simply, as should always be done, and so pass over the head as well as the pistil, since they suffer no visible change by the formation of the brand. The same is true of the glumes and petals, the anthers and the spike of the ears themselves.

The fruit or seed of the wheat viewed on the outside, consists of an elongated irregularly egg-shaped body (fig. 16, *f*), having on the front surface a streak or furrow lengthwise, (fig. 16, *k*), which bears on the point the pistil (fig. 16, *i*), and the head (fig. 16, *h*).

At the bottom, we see on the back the little shield (fig. 15) containing the germ, and the front side the little opening, *Feusterchen* (fig. 16, *g*). If the seed is cut across through the middle (fig. 18), we find that it has an outer skin (fig. 18, *l*), which by bending inward forms the furrow lengthwise (*k*). Inside of this skin are found white hard transparent bodies containing starch-meal, which natural historians call the albuminous bodies, "the albumen" of the seed (fig. 18, *m*). If now we cut off as thin as possible a slice perfectly transparent, in the direction already mentioned, and examine the same microscopically, we find that,

1. The skin of the seed (fig. 18, *l*) consists of three layers, to wit:

a. The outer layer (fig. 19, *n*);

b. The middle layer (fig. 19, *o*); and

c. The inner layer (fig. 19, *p*), on which layer immediately lies a large soft cellular stratum, which contains the grains of gluten (fig. 19, *q*). Nearest the inside lie the amylum cells, containing the starch-meal (fig. 19, *r*, *s*).

a. The outer layer of the seed-skin (fig. 19, *n*), consists of two layers of thick-walled porous cells, which stand with their longest diameter parallel to the axis of the seed, and the walls of which contain slight hollows or little canals, which, in a section cut lengthwise and very strongly magnified (fig. 20, *w*), give to the cellular walls a form as if they were formed of oblong figures.

b. The second layer (fig. 19, *o*) of the seed-skin, consists of similar cells to those of the first layer, only the walls of the cells are not so thick; and the pores, which these walls contain are much more distinctly (fig. 19, *o*) to be seen, than is the case in the cellular walls of the first layer of the skin; but the cells of this layer stand with axis of length horizontally to the axis of the first cellular layer and of the seed, and therefore runs as it were parallel to the outer surface of the seed. In a section lengthwise they resemble even to the direction of the cells of the first layer of cells, and are nearly as large as they are (fig. 20. *x*, *x*).

c. The third layer is extremely soft and somewhat confused. Its cells are so small, that we can discern their hollows only indistinctly and in the form of mere streaks (fig. 19, *p*).

2. Directly under this cellular stratum or of the seed-skin in general, we find situated the already mentioned cells of gluten (fig. 19, *q*). They are large bag-formed cells, with

extremely thin scarcely visible cellular walls, which are filled exclusively with the gluten, a small-grained, greasy, smutty-gray substance, approaching to yellow. Under these cells of gluten lie, first,

3. The albuminous bodies of the seed, which consist of large six-sided prismatic cells (fig. 19, *r*), the walls of which are soft, clear as glass, and perfectly transparent; and the hollow space in the ripe seed is filled with little grains of starch-meal (fig. 19, *s*; fig. 22). These latter are round or irregularly egg-shaped, transparent and white, and consist of concentric layers or peels (fig. 22), the outer of which often bursts or springs open. Between the grains of amylum or starch-meal are found still smaller grains which consist almost wholly of starch, and must be regarded as little grains of amylum.

At the base of the seed below the little shield lies the embryo plant or germ; but as the same is scarcely ever found in the bud of wheat which is affected with brand, the consideration of this here does not belong to the province of this essay, since no immediate transforming influence can be referred to it.

If now after the minute examination of the sound seed, we compare with it the structure of that which is affected by brand, we find that the diseased seed (fig. 4) is wholly changed as well in respect to its form as to its structure. It has become shorter and thicker, and not as in the sound seed tapering towards the top (fig. 16), but increased in thickness (fig. 4). On its base, or on the head, the anthers remain hanging or standing, while in the sound seed they have long since fallen off. The head with the pistil (fig. 4, *c*) is broader, and the outer skin (*a*) of the seed corn affected by brand is rougher and fine punctured.

Let a seed corn thus affected by brand be cut through horizontally, and it be examined under a magnifying glass (fig. 5), we find outwardly a simple outer skin, and internally a dark black substance often approaching to violet, which is extremely fine grained and greasy, gives out a foul penetrating ammoniacal smell, and on being dried falls to powder. In the middle of the grain affected by brand we generally see a clearer colored square gray spot, which on close examination is found to consist of the remains of the former cellular texture. If now we examine more closely the particular organs of such a kernel affected with brand, we find that the outer skin of the seed thus affected consists of a single stiff layer of cells (fig. 21), the cells of which in respect to their form and size resemble much the outer cellular layer of the seed-skin of the sound seed (fig. 20, *w*); but their walls are no longer porous, but paper-like, stiff and folded lengthwise: they are not so finely colored as in the sound seed, but are of a smutty earth color. The second and third cellular layer (fig. 19, *o*, *p*) of the sound seed, has wholly disappeared in the diseased one: the same is true of the cells of gluten, of which not a single trace remains.

On examining still more minutely the black smutty mass, which fills the space designed for the albuminous bodies, we find that here and there it contains some particles of cellular tissue, like the celluar tissue of the albuminous bodies, but the cells themselves are much widened (fig. 6, *d*) and folded; but the hollow spaces are filled with grains of brand (fig. 6, *e*). Should the brand not be fully ripe or developed, we find the cellular tissue still

entirely preserved and connected together, but without any traces of amylum. This latter is scarcely ever developed in diseased seed, but in place of it are formed clear globular cells of the same size (fig. 7), which we instantly distinguish as the young grains of brand. These by form are oily-grained contents (fig. 7), which increases with the advancing growth of the same (fig. 8); and their cellular skin, previously clear as glass, and white, becomes brownish colored. In the later growth we find the entire cells of brand (fig. 9) filled with little oil-drops; and the cellular wall is of pale violet color, but it is still smooth. These cells, natural historians call the spores or seeds of the fungi which constitute the brand; and in the advancing growth the cellular skin, which is the seed skin of the spore, gradually becomes dark colored and covered with fine warts, while at the same time the little oil-drops visibly increase in the space of the spore-skin, and finally flow into a compact yet scarcely discernible body (fig. 10).

But if we thoroughly examine the ripe spores of brand, and we happen to obtain good sections of the same — a problem extremely difficult on account of the minuteness of the body to be cut, and only to be secured by chance — then we see that the spore-skin (figs. 11, 12, *t*, *t*) of the brand-spore forms a dark colored single membrane uneven on the outer surface, which encloses in its hollow space a second transparent cell (figs. 11, 12, 13, *u*, *u*, *u*), which forms the second or inner spore-skin; but in the space of the second spore-skin we find a waxy, curved body (figs. 11, 13, *v*, *v*), which is called the kernel of the spore, and which, in spores not yet fully ripe, appears to be surrounded with little drops of oil. The spores, compared to other of the different kinds of brand, are large, and their linear diameter is from 0·000700 to 0·000730 ($\frac{1}{1428}$) of a Paris inch. The spores distinguish this species of brand from all others which habitate wheat, and their specific gravity is greater than that of water: they sink therefore in water, and hence the seed which is affected by brand may be cleaned with running water, as it is thus also clear that well washed seed suffers less from the brand. But the seed must be thoroughly washed before sowing, in order that the spores of the brand, which may still be in the furrow of the seed and among the chaff-hairs of the head, may be removed.

Here is not the place to quote all the various opinions of the husbandmen and natural historians respecting the existence and propagation of the brand in the various kinds of grain generally. The conviction and view of every individual is so peculiar a matter, which rests on such different grounds of representation and positive induction, that opposition to even the crudest ideas (and so-called experience), according to my multifarious observation, is only injurious.

Yet I may be allowed to maintain here as preliminary, that the view which regards the brand merely as a stage of disease, or a disease analogous to the organic diseases of the animals, must indeed be false. I can only compare the parasitic formations which belong to the class of fungi or mushrooms, to the phthiriasis or the louse disease, and in this case *no spontaneous generation* is supposed. We have one of the most decisive proofs in the case of a majority of exotic plants which are evidently produced from seed, and no parasites (especially eutophytes) have been imported from their native country; while in our glass-

house, all the plants known to me as having been brought alive from the tropic have introduced certain eutophytes peculiar each to its species of plants, and not belonging to this country. The great idea of DE CANDOLLE, "the spreading of the species of brand depends on the sowing of the spores," since the beautiful observations which GLEICHEN published more than sixty years ago, can no more be doubted. This great German natural historian found indeed that the wheat crop strewn and sown with brand dust gave over 50 per cent of ears affected by brand, while the dry and thoroughly washed seed exhibited scarcely any ears affected by brand.

Besides many eutophytes may be transported; and in the kinds of brand of grain we are by no means justified in denying the transmission by spores, and especially as no husbandman can maintain "that he has cultivated wholly clean seed containing not a single brand-spore," for in practice the extraordinary minuteness of the brand-spores lays an insurmountable obstacle in the way of all observations. The parasites which have their abode in the dead parts of plants may easily be propagated by the sowing of their spores; and a careful observer may in this latter case readily follow the germ of the spores sown, and the gradual development of the parasite through all the stages of its formation, as I have already many times shown in other places. But a multitude of eutophytes, besides the sowing by spores, also require peculiar conditions of soil and a moist atmosphere for their development; since otherwise the mother plant is not capable of furnishing the nutrition indispensable for its development, or to perform the secretion of the same from its own fluids.

These organic processes necessary to such formations are yet partially mysteries to natural historians, which may not be laid open by logical phrases, or such as belong to natural philosophy. Only direct observations can here determine; and all views, opinions, belief, and so-called experience are positively injurious, while they are almost ever wanting in any strong induction, and under critical examination sink into their original nothingness. It is therefore the wiser openly to admit that we have not yet observed the direct propagation of the kinds of brand by spores; as we must allow, on a critical investigation of all circumstances, "*that the conditions of soil, the influence of cultivation, weather, situation and manure which is required for the spreading of the various species of brand*, are not fully known." Such conclusions are more salutary for the advancement of human knowledge, than all the so-called learned or purely empirical talk.

But since EHRENBERG has practically demonstrated the propagation of the infusoria by eggs and division, and I have also the sowing of fungi and mushrooms by spores, we may too hope for a similar proof of the propagation of eutophytes by spores, and until then set aside all speculations on their spontaneous generation as injurious and unnecessary; and the more so, as nearly every kind of plant has parasites exclusively having their abode in it, and likewise the soil equally necessary to its development.

Explanation of the Illustrations.

Plate LV, fig. 1, an ear affected with brand of the natural size. Figs. 2 and 3, seed kernels affected with brand, with and without anthers, of the natural size. Fig. 4, a seed kernel affected by the brand, greatly magnified : *a*, the seed kernel with the fold lengthwise; *bb*, anthers, which stick to the head of the same, and on the pistils, *c*, interwoven by fungous fibres. Fig. 5, a horizontal section of same greatly magnified. Fig. 6, a cell of this section, with brand-spores, *e*, greatly magnified. Fig. 7, an entire young brand-spore. Figs. 8, 9, older brand-spores, before the formation of the kernel and spore-skin. Fig. 10, four ripe brand-spores strongly magnified. Fig. 11, section of a spore very greatly magnified : *t*, spore-skin; *u*, inner spore-skin; *v*, kernel of the spore surrounded with little drops of oil. Fig. 12, a single spore of this kind where the kernel of the spore *v*, with the inner spore-skin *u* yet lies in the hollow space of the outer spore-skin *t*. Fig. 13, a kernel of the spore *v*, represented alone with the inner spore-skin *u*, greatly magnified. Fig. 14, a sound, ripe wheat kernel, front view. Fig. 15, the same, back view, with the little shield, natural size. Fig. 16, the same, greatly magnified : *f*, the seed-kernel, with the seed-skin; *k*, the fold lengthwise; *g*, the little opening; *h*, the head; *i*, the pistils. Fig. 17, horizontal section of the same through the centre, and fig. 18, slightly magnified : *l*, the seed-skin; *k*, the fold; *m*, the albuminous bodies. Fig. 19, a thinner section of the wheat kernel strongly magnified : *n*, the cellular layers of the first seed-skin; *o*, the second; *p*, the third or innermost seed-skin; *g*, the cells of gluten; *r*, the cellular tissue of the albumen with grains of starch-meal, *s*. Fig. 20, external view of a very delicate vertical section of the seed-skin of a sound kernel of wheat strongly magnified : *w*, outer cellular layer; *xx*, inner cellular layer of the same greatly magnified. Fig. 21, the outer skin of a wheat kernel affected with brand of the same ear, strongly magnified. Fig. 22, little grains of amylum very strongly magnified.

VI. MAIZE, OR INDIAN CORN.

American farmers regard indian corn as one of the most important crops; indeed, for general usefulness, it must be regarded as inferior to none. For family use, it occupies a prominent place. Although in the state of society it is not used so much for bread as wheat, still there are so many modes of cooking it, by which dishes are improved, that it is nearly indispensable. For domestic animals, it is far more important than wheat. Its oil, and other elements place it among the most fattening of the cereals : thus its parts, as the leaves and stalks, furnish a fodder superior to straw. Indeed there is really nothing in the crop which may not be turned to account : even the cob should not be thrown away. Were the sugar cane to become extinct, the stalks of indian corn would become a substitute, and sugar would be one of the essential products of the corn crop.

TIME.	PARTS.	QUANTITY.	PER CENTUM.
JULY 18.	1. *Leaves*	886·1 grs.	
	Dry	16·2	
	Water	869·9	
	Ash	13·48	1·52
	Dry matter		28·28
	Ash calculated dry		8·32
	2. *Sheaths*	457·3	
	Dry	46·5	
	Water	410·8	
	Ash	5·27	1·13
	Ash calculated dry		11·333
	Dry matter		10·167
	3. *Stalks*	1084·2	
	Dry	96·5	
	Water	987·7	
	Ash	8·04	·74
	Ash calculated dry		7·474
	Dry matter		13·025
	4. *Tassels*	149·4	
	Dry	37·1	
	Water	112·3	
	Ash	2·77	1·854
	Ash calculated dry		7·466
	Dry matter		24·83
	5. *Silks*	44·48	
	Dry	5·	
	Water	39·48	
	Ash	·405	·933
	Ash calculated dry		8·3
	Dry matter		11·24
JULY 29.	1. *Leaves*	2294·	
	Dry	458·5	
	Water	1835·5	
	Ash	41·58	1·812
	Ash calculated dry		9·068
	Dry matter		20·42
	2. *Sheaths*	3345·	
	Dry	399·	
	Water	2846·	
	Ash	25·49	·765
	Ash calculated dry		6·388
	Dry matter		11·92

TIME.	PARTS.	QUANTITY.	PER CENTUM.
JULY 29.	3. *Stalks*	3041· grs.	
	Dry	370·	
	Water	2671·	
	Ash	16·22	·533
	Ash calculated dry		4·383
	Dry matter		12·16
	4. *Tassels*	87·2	
	Dry	40·	
	Water	47·2	
	Ash	1·85	2·121
	Ash calculated dry		4·625
	Dry matter		45·884
	5. *Silks*	426·5	
	Dry	36·	
	Water	390·5	
	Ash	1·92	·45
	Ash calculated dry		5·333
	Dry matter		8·444
AUGUST 4.	1. *Leaves*	2810·	
	Dry	631·	
	Water	2179·	
	Ash	58·97	2·09
	Ash calculated dry		9·367
	Dry matter		22·099
	2. *Sheaths*	3124·5	
	Dry	514·5	
	Water	2610·	
	Ash	32·	1·02
	Ash calculated dry		6·21
	Dry matter		16·466
	3. *Stalks*	5219·	
	Dry	654·5	
	Water	625·02	
	Ash	29·48	·564
	Ash calculated dry		4·54
	Dry matter		12·52
	4. *Immature grain and cob*	433·	
	Dry	36·6	
	Water	396·4	
	Ash	3·49	·806
	Ash calculated dry		9·53
	Dry matter		8·45

TIME.	PARTS.	QUANTITY.	PER CENTUM.
August 4.	5. *Husks*	2439· grs.	
	Dry	330·5	
	Water	2108·5	
	Ash	12·22	·501
	Ash calculated dry		3·697
	Dry matter		13·59
	6. *Tassels*	184·	
	Dry	68·5	
	Water	115·5	
	Ash	4·74	·252
	Ash calculated dry		6·919
	Dry matter		37·22
	7. *Silks*	700·	
	Dry	70·5	
	Water	629·5	
	Ash	4·	·571
	Ash calculated dry		5·674
	Dry matter		10·007
August 11.	1. *Leaves*	1642·	
	Dry	415·5	
	Ash	36·59	2·022
	Ash calculated dry		8·806
	Dry matter		25·29
	2. *Sheaths*	2709·	
	Dry	729·	
	Water	1980·	
	Ash	35·86	1·324
	Ash calculated dry		3·92
	Dry matter		26·99
	3. *Stalks*	4577·	
	Dry	744·2	
	Water	3832·8	
	Ash	51·25	1·119
	Ash calculated dry		6·86
	Dry matter		16·05
	4. *Husks*	2375·	
	Dry	242·5	
	Water	2132·5	
	Ash	7·35	·31
	Ash calculated dry		3·031
	Dry matter		41·21

TIME.	PARTS.	QUANTITY.	PER CENTUM.
August 11.	5. *Cobs* - - - - - - - -	3000· grs.	
	Dry - - - - - - - -	609·	
	Water - - - - - - -	2391·	
	Ash - - - - - - - -	14·61	·486
	Ash calculated dry - - - -		2·234
	Dry matter - - - - -		20·3
	6. *Kernels* - - - - - - -	1830·	
	Dry - - - - - - - -	384·5	
	Water - - - - - - -	1445·5	
	Ash - - - - - - - -	13·865	·758
	Ash calculated dry - - - -		3·605
	Dry matter - - - - - -		21·01
	7. *Silks* - - - - - - - -	199·	
	Dry - - - - - - - -	28·	
	Water - - - - - - -	161·	
	Ash - - - - - - - -	1·91	·95
	Ash calculated dry - - - -		
	8. *Tassels* - - - - - - - -	123·7	
	Dry - - - - - - - -	47·	
	Water - - - - - - -	76·76	
	Ash - - - - - - - -	4·1	3·31
	Ash calculated dry - - - -		8.74
	Dry matter - - - - - -		37·99
August 23.	1. *Leaves* - - - - - - - -	707·	
	Dry - - - - - - - -	197·	
	Water - - - - - - -	510·	
	Ash - - - - - - - -	17·84	2·523
	Ash calculated dry - - - -		8·954
	Dry matter - - - - -		27·87
	2. *Sheaths* - - - - - - -	590·5	
	Dry - - - - - - - -	112·	
	Water - - - - - - -	478·5	
	Ash - - - - - - - -	10·02	1·79
	Ash calculated dry - - - -		8·946
	Dry matter - - - - -		18·96
	3. *Stalks* - - - - - - - -	2237·	
	Dry - - - - - - - -	225·5	
	Water - - - - - - -	1911·5	
	Ash - - - - - - - -	13·72	·61
	Ash calculated dry - - - -		4·215
	Dry matter - - - - - -		14·55

			QUANTITY.	PER CENTUM.
August 23.	4. *Husks* [illegible]		1218· grs.	
	Dry [illegible]		277·	
	Water		941·	
	Ash		10·72	·88
	Ash calculated dry			3·871
	Dry matter			22·74
	5. *Cobs* [illegible]		1481·	
	Dry [illegible]		404·	
	Water [illegible]		1077·	
	Ash [illegible]		8·225	·556
	Ash calculated dry			2·033
	Dry matter			27·28
	6. *Kernels* [illegible]		1840·	
	Dry [illegible]		730·3	
	Water [illegible]		1109·7	
	Ash [illegible]		13·96	·758
	Ash calculated dry			1·919
	Dry matter			39·67
	7. *Tassels*		58·	
	Dry		14·	
	Water		44·	
	Ash		3·1	·534
	Ash calculated dry			·704
	Dry matter			24·
	8. *Silks* [illegible]		167·56	
	Dry [illegible]		20·	
	Water [illegible]		147·56	
	Ash		·76	·045
	Ash calculated dry			3·8
	Dry matter			11·9
September 1.	1. *Kernels* [illegible]		400·	
	Dry [illegible]		249·9	
	Water [illegible]		150·1	
	Ash		4·21 (some coal).	
	2. *Cobs*		931·	
	Dry [illegible]		361·5	
	Water		569·5	61·16
	Ash		5·39	·539
	Ash calculated dry			1·491
	Dry matter			38·82

DATE.	PARTS.	QUANTITY.	PER CENTUM.
SEPTEMBER 1.	3. *Leaves*	1058· grs.	
	Dry	449·	
	Water	609·	
	Ash	52·7	4·98
	Ash calculated dry		13.96
	Dry matter		42·53
	4. *Husks*	1391·	
	Dry	405·5	
	Water	985·5	70·78
	Ash	19·2	1·38
	Ash calculated dry		4·734
	Dry matter		29·1
	5. *Sheaths* (lost)		
	Dry	207·	
	Water		
	Ash	19·25	
	Ash calculated dry		9·29

NOTE. The plant taken for August 23 happened to be one proportionally smaller than the preceding, yet at this time the leaves began to dry and wither; but this lightness of the herbage will increase with the development of the grain.

II. WHITE-FLINT CORN.

AUGUST 22.	1. *Tassels*	130·7 grs.	
	Dry	57·	
	Water	83·7	
	Ash	4·37	3·34
	Ash calculated dry		7·666
	Dry matter		43·67
	2. *Stalks*	5766·9	
	Dry	880·1	
	Water		
	Ash	35·75	·691
	Ash calculated dry		4·006
	Dry matter		15·26
	3. *Leaves*	2797·	
	Dry	763·8	
	Water	2033·2	
	Ash	81·35	2·908
	Ash calculated dry		10·637
	Dry matter		27·31

TIME.	PARTS.	QUANTITY.	PER CENTUM.
August 22.	4. *Silks*	57· grs.	
	Dry	36·	
	Water	21·	
	Ash	1·72	3·1
	Ash calculated dry		4·777
	Dry matter		63·1
	5. *Sheaths*	2536·	
	Dry	494·	
	Water	2042·	
	Ash	40·46	1·596
	Ash calculated dry		8·192
	Dry matter		19·47
	6. *Husks*	3534·	
	Dry	802·	
	Water	2732·	
	Ash	29·53	·835
	Ash calculated dry		3·682
	Dry matter		22·68
	7. *Cobs*	2935·5	
	Dry	864·	
	Water	2070·5	70·53
	Ash	18·	·613
	Ash calculated dry		2·063
	Dry matter		29·46
	8. *Kernels*	4170·5 (fully glazed).	
	Dry	1633·	
	Water	2537·5	60·84
	Ash	32·7	·759
	Ash calculated dry		2·002
	Dry matter		39·15

III. CORN MIXED WITH LARGE WHITE-FLINT AND TUSCARORA.

September 26.	1. *Leaves*	2198·5 grs.	
	Dry	476·	
	Water		
	Ash	58·	2·061
	Ash calculated dry		12·05
	Dry matter		21·64
	2. *Stalks*	7552·5	
	Dry	1290·	
	Water		
	Ash	44·61	·59
	Ash calculated dry		3·533
	Dry matter		17·08

TIME.	PARTS.	QUANTITY.	PER CENTUM.
SEPTEMBER 26.	3. *Sheaths* - - - - - - -	2176· grs.	
	Dry - - - - - - - -	512·3	
	Water - - - - - - -	1663·7	
	Ash - - - - - - - -	34·1	1·566
	Ash calculated dry - - - -		6·686
	Dry matter - - - - -		23·54
	4. *Husks* - - - - - - - -	1972·5	
	Dry - - - - - - - -	440·3	
	Water - - - - - - -	1532·2	
	Ash - - - - - - - -	12·08	·612
	Ash calculated dry - - - -		2·743
	Dry matter - - - - -		22·27
	5. *Cobs* - - - - - - - -	1773·	
	Dry - - - - - - - -	630·	
	Water - - - - - - -	1143·	64·46
	Ash - - - - - - - -	11·25	·634
	Ash calculated dry - - - -		1·785
	Dry matter - - - - -		35·53
	6. *Kernels* of one ear - - - -	3344·	
	Dry - - - - - - - -	1744·7	
	Water - - - - - - -	1599·3	47·82
	Ash - - - - - - - -	23·625	1·706
	Ash calculated dry - - - -		1·354
	Dry matter - - - - -		52·14
	Weight of foliage - - - - -	15672·5 grs.	
	Dry - - - - - - - -	3548·6	
	Ash - - - - - - - -	160·04	
	Weight of kernels - - - - -	3344·	
	Dry kernels - - - - - -	1744·7	
	Total weight of one green plant - -	19016·5	
	Total weight when dry - - - -	5293·3	
	Total amount of water - - - -	183723·2	

REMARKS ON THE FOREGOING OBSERVATIONS.

A variety of facts relating to the progress of the crop may be deduced from the observations, which may be regarded as correct in the main.

The increase in weight, in ten days, of a single plant, an individual stalk, is as follows, taking the interval between the 18th and 29th of July, during which period corn probably grows as rapidly as at any other time :

Increase in weight - - - - -	6571·52 grs.
Increase in solid organic matter - - -	1112·2
Total weight of the plant July 29 - -	9193·
Containing water - - - - -	7889·5

The increase, therefore, of the plant every day, amounts to 657 grs., of which 546 are water and 111 dry matter.

August 10.	The individual plant weighed - - - -	16455· grs.
	Containing water - - - - - -	13255·3
	Dry matter - - - - - - -	3199·7
	Total increase in weight from July 29 to August 11,	7262·
	Increase per day for 11 days - - - -	660·
	Inorganic matter assimilated August 11 -	195·54
	Inorganic matter assimilated July 29 - -	87·06
	Increase from July 29 to August 11 - -	108·48

Increase of inorganic matter about 10 grs. per day.

It will be observed that the increase in weight for two periods, from July 18 to July 29, and from July 29 to August 11, is virtually equal, only three additional grains remaining in favor of the last period (See Meteorological Observations and Tables at the end of the volume). The perfect solution of the inorganic matter is maintained by the large amount of water always circulating in the plant : thus, in August 11, there was 13255 grs. of water, and only 165½ grs. of mineral matter.

IV. EARLY WHITE-FLINT CORN.

Relation of the different parts of the plant to each other; observations, and the quantity of water, dry matter and ash in the several parts at different stages of its growth.—S.

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
JUNE 3.	Corn planted.		
JUNE 11.	Plants begin to show themselves above the soil.		
JUNE 15.	Plants 5 inches high. Average weight of each plant - - - - - - - - -	10·8925 grs.	
	PROPORTIONS.		
	Weight of four plants cut close to the roots -	43·57	
	Water - - - - - - - -	39·05	89·626
	Dry matter - - - - - - -	4·52	10·374
	Ash - - - - - - - - -	·59	1·354
	Percentage of ash calculated on the dry matter,		13·063

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
JUNE 21.	Average height of plants 10½ inches. Growth during the last 6 days, 5½ inches, which is a little less than 1 inch per day.		
	Average weight of each plant - - -	22·1 grs.	
	Average increase of weight of each plant during the last 6 days - - - - - - -	11·2075	
	PROPORTIONS.		
	Weight of four plants cut close to roots - -	88·4	
	Water - - - - - - - -	78·86	89·208
	Dry matter - - - - - - -	9·54	10·792
	Ash - - - - - - - -	1·83	2·07
	Percentage of ash calculated on the dry matter,		19·182
JUNE 28.	Average height, 18 inches. Increase in height during the last week, 7½ inches. Before this, the plants have been made up entirely of leaves. The sheaths now begin to form on the longest leaves.		
	Average weight of each plant - - -	84·15 grs.	
	Average increase in weight during the last week, being about 9 grs. per day.	62·05	
	Took three plants : divided each plant into the part above the soil, and the part in it.		
	Relation of the part above the soil, to the part in it :		
	Part above the soil - - - - -	206·7	81·877
	Part in the soil - - - - - -	45·75	18·123
	Whole weight of the three plants - -	252·45	
	Divided the part above the soil into leaves and sheaths.		
	Relation of leaves and sheaths :		
	Leaves - - - - - - - -	163·3	79·003
	Sheaths - - - - - - - -	43·4	20·997
		206·7	100·
	PROPORTIONS.		
	1. *Leaves* - - - - - - - -	163·3	
	Water - - - - - - - -	141·44	86·613
	Dry matter - - - - - - -	21·86	13·387
	Ash - - - - - - - -	2·34	1·433
	Percentage of ash calculated on dry matter -		10·704
	Ash tastes decidedly of caustic potash.		

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
JUNE 28.	2. *Sheaths* of three plants weighed - - -	43·4 grs.	
	Water - - - - - - - -	40·12	92·442
	Dry matter - - - - - -	3·28	7·558
	Ash - - - - - - - -	·48	1·106
	Percentage of ash calculated on dry matter -		14·628
	Ash saline, with a slight taste of caustic potash.		
	Part of plant in the soil contains a large percentage of sugar. This part, from six plants, weighed - - - - - - - -	91·5	
	Water - - - - - - - -	84·39	92·229
	Dry matter - - - - - -	7·11	7·771
	Ash - - - - - - - -	1·20	1·311
	Percentage of ash calculated on the dry matter,		16·878
	Ash very saline, greenish, more difficult to burn than the leaves.		
JULY 5.	Average height, 26 inches, Growth during the last week, 8 inches : a little over 1 inch per day.		
	Weight of one plant - - - - - -	237·5 grs.	
	Increase of weight during the last week -	152·35	
	Average increase of weight of each plant per day,	21·764	
	The stalk begins to form.		
	Relation of the different parts to each other :		
	Stalk ($\frac{3}{4}$ inch long, with 3 joints) - -	6·75	2·844
	Sheaths - - - - - - -	62·5	26·312
	Leaves - - - - - - - -	168·25	70·844
		237·5	100·
	PROPORTIONS.		
	1. *Stalks* - - - - - - - - -	6·75	
	Water - - - - - - - -	6·11	90·518
	Dry matter - - - - - -	·64	9·482
	Ash - - - - - - - -	·09	1·333
	Percentage of ash calculated on dry matter -		14·101
	Ash very saline.		
	2. *Sheaths* - - - - - - - -	62·5	
	Water - - - - - - - -	57·92	92·672
	Dry matter - - - - - -	4·55	7·288
	Ash - - - - - - - -	·65	1·04
	Percentage of ash calculated on dry matter -		14·285
	Ash saline.		

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
JULY 5.	3. *Leaves* - - - - - - - - -	168·25 grs.	
	Water - - - - - - - -	146·5	81·01
	Dry matter - - - - - - -	21·75	18·99
	Ash - - - - - - - -	2·1	1·248
	Percentage of ash calculated on dry matter -		6·566
	Ash saline, with a slight taste of caustic potash.		
	Roots washed thoroughly with cold water, and the adhering moisture separated by pressing in paper.		
	4. *Roots* of one plant - - - - - -	77·	
	Water - - - - - - - -	64·69	84·013
	Dry matter - - - - - - -	12·31	15·987
	Ash - - - - - - - -	1·22	1·584
	Percentage of ash calculated on dry matter -		9·908
JULY 12.	Average height of plants, 35 inches. Average increase of height of each plant during the last week, 9 inches : over 1 inch per day. Corn has been hoed twice; the first time on the 15th of June, the last on the 5th of July. Stalks about 1¼ inches long, with 4 joints. The old kernels attached to the roots completely absorbed, leaving nothing but the epidermis. Longest roots extend from 5–8 inches downwards, and from 8–10 inches laterally. Each plant has generally 12 leaves; 7 of these have sheaths. Growth moderately thrifty.		
	Weight of one plant - - - - -	681·9 grs.	
	Increase in weight of each plant during the last week - - - - - - - -	432·7	
	Average increase in weight of each plant per day, being 2¼ grs. per hour.	61·814	
	Relation of the different parts of one plant to each other:		
	Stalk - - - - - - - -	40·4	5·926
	Sheaths - - - - - - -	216·1	31·678
	Leaves - - - - - - - -	413·7	60·679
	Roots - - - - - - - -	11·7	1·717
	Weight of one plant - - - -	681·9	100·

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGES.
	PROPORTIONS.		
JULY 12.	1. *Stalk*	40·4 grs.	
	Water	38·06	94·203
	Dry matter	2·34	5·792
	Ash	·42	1·039
	Percentage of ash calculated on the dry matter,		17·949
	Ash tastes decidedly of caustic potash.		
	2. *Sheaths*	216·1	
	Water	204·55	94·655
	Dry matter	11·55	5·345
	Ash	1·23	·569
	Percentage of ash calculated on the dry matter,		10·649
	Ash saline, with a slight taste of caustic potash.		
	3. *Leaves*	413·7	
	Water	366·81	88·665
	Dry matter	46·89	11·335
	Ash	5·12	4·268
	Percentage of ash calculated on dry matter		11·37
	Ash decidedly saline.		
	4. *Roots* (treated the same as those on the 5th)	11·7	
	Water	9·48	81·026
	Dry matter	2·22	18·974
	Ash	·26	2·222
	Percentage of ash calculated on dry matter		11·711
	Ash tastes of caustic potash.		
JULY 19.	Average height of corn, 43 inches. Increase in height during the last week, 8 inches : a trifle over 1 inch per day.		
	About the average weight of each plant	875·43 grs.	
	Increase in weight during the last week	177·197	
	Increase in weight per day	25·317	
	which is a little over 1 grain per hour.		
	The longest roots extend into the soil 12 inches. 8 leaves have sheaths. Stalk 2¼ inches long, with 7 joints.		
	Relation of the different parts of one plant to each other:		
	Stalk	60·4	6·899
	Sheaths	242·5	27·699
	Leaves	544·5	62·194
	Roots	28·03	3·203
	Weight of one plant	875·43	100·

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS. PROPORTIONS.	QUANTITIES.	PERCENTAGE.
JULY 19.	1. *Stalk* - - - - - - - - -	60·4 grs.	
	Water - - - - - - - -	56·16	92·98
	Dry matter - - - - - - -	4·24	7·02
	Ash - - - - - - - -	·68	1·126
	Percentage of ash calculated on the dry matter,		16·038
	Ash tastes decidedly of caustic potash.		
	2. *Sheaths* - - - - - - - -	242·5	
	Water - - - - - - - -	225·75	93·092
	Dry matter - - - - - - -	16·75	6·908
	Ash - - - - - - - -	2·62	1·081
	Percentage of ash calculated on the dry matter,		15·642
	Ash tastes of salt and potash.		
	3. *Leaves* - - - - - - - - -	544·5	
	Water - - - - - - - -	479·25	88·016
	Dry matter - - - - - - -	65·25	11·984
	Ash - - - - - - - -	6·64	1·219
	Percentage of ash calculated on the dry matter,		10·176
	Ash saline, with a slight taste of caustic potash.		
	4. *Roots* (treated as before described) - -	140·4	
	Water - - - - - - - -	121·87	86·802
	Dry matter - - - - - - -	18·53	13·198
	Ash - - - - - - - -	1·76	1·253
	Percentage of ash calculated on the dry matter,		9·498
JULY 26.	Average height of corn, 49 inches. Increase in height during the last week, 6 inches : a little less than 1 inch per day. Length of stalk from 4 – 5½ inches, with 8 joints. Tassels from 1 – 3 inches in length.		
	About the average weight of each plant - -	2039· grs.	
	Increase in weight during the last week -	1191·6	
	Average increase in weight per day - -	170·22	
	Average increase in weight per hour - -	7·09	
	Relation of the different parts of one plant to each other :		
	Stalk - - - - - - - -	338·8	16·125
	Sheaths - - - - - - -	690·5	34·056
	Leaves - - - - - - - -	1002·5	49·466
	Tassels - - - - - - - -	7·2	·353
		2039·	100·

ANALYSES OF MAIZE.

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
	PROPORTIONS.		
JULY 26.	1. *Stalk*	338·8 grs.	
	Water	317·12	93·601
	Dry matter	21·68	6·399
	Ash	3·83	1·131
	Percentage of ash calculated on the dry matter,		17·666
	Ash tastes decidedly of caustic potash.		
	2. *Sheaths*	690·5	
	Water	646 03	91·822
	Dry matter	44·47	8·178
	Ash	7·33	1·615
	Percentage of ash calculated on the dry matter,		16·483
	3. *Leaves*	1002·5	
	Water	857·15	85·501
	Dry matter	145·35	14·499
	Ash	15·3	1·526
	Percentage of ash calculated on the dry matter,		15·263
	4. *Tassels*	7·2	
	Water	6·45	89·583
	Dry matter	·75	10·417
	Ash	·11	1·528
	Percentage of ash calculated on the dry matter,		14·667
	5. *Roots*	91·4	
	Water	78·57	85·962
	Dry matter	12·83	14·038
	Ash	·80	·875
	Percentage of ash calculated on the dry matter,		6·235
AUGUST 2.	Average height of corn, 58 inches. Increase in height during the last week, 9 inches; being about 1¼ inches per day. Tassel 12 inches long: does not show itself yet above the sheaths. Stalk 12 inches in length, with 11 joints. Eleven or all of the leaves have sheaths.		
	About the average weight of each plant	[illegible] grs.	
	Increase in weight during the last week	[illegible]	
	Average increase in weight per day	181·31	
	Average increase in weight per hour	7·555	

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
August 2.	Relation of the different parts of the plant to each other:		
	Stalk	982· grs.	28·167
	Sheaths	847·	24·294
	Leaves	1358·	38·951
	Tassels	121·4	3·482
	Roots	178·	5·106
	Weight of 1 plant	3486·4	100·
	PROPORTIONS.		
	1. *Stalks*	982·	
	Water	929·15	93·999
	Dry matter	52·85	6·001
	Ash	7·95	·809
	Percentage of ash calculated on the dry matter,		13·481
	2. *Sheaths*	847·	
	Water		
	Dry matter		
	Ash	9·22	1·088
	Percentage of ash calculated on the dry matter,		
	Omitted weighing after sheaths were dry.		
	3. *Leaves*	1358·	
	Water	1178·5	86·782
	Dry matter	179·5	13·218
	Ash	17·35	1·277
	Percentage of ash calculated on the dry matter,		9·666
	4. *Tassels*	121·4	
	Water	109·72	90·379
	Dry matter	11·68	9·621
	Ash	1·03	·848
	Percentage of ash calculated on the dry matter,		8·818
	5. *Roots*	178·	
	Water	155·22	87·202
	Dry matter	22·78	12·798
	Ash	1·73	·972
	Percentage of ash calculated on the dry matter,		7·595
August 9.	Average height of corn, 65 inches. Increase in height during the last week, 7 inches, or 1 inch per day. Tassels have extended themselves from 2 – 4 inches above the sheaths. Average length of stalk, 22 inches. Increase in length during the last week, 10 inches. Each stalk has 13 joints, and the same number of leaves and sheaths.		

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
AUGUST 9.	About the average weight of each plant - -	3827·5 grs.	
	Increase in weight during the last week - -	286·1	
	Average increase in weight per day - -	11·92	
	Average increase in weight per hour - -	·49	
	Relation of the different parts of the plant to each other:		
	Stalk - - - - - - - -	1241·	32·413
	Sheaths - - - - - - -	904·5	23·63
	Leaves - - - - - - - -	1216·	31·769
	Tassels - - - - - - - -	233·	6·094
	Roots - - - - - - - -	233·	6·094
	Weight of 1 plant - - - - -	3827·5	100·
	PROPORTIONS.		
	1. *Stalk* - - - - - - - -	1241·	
	Water - - - - - - - -	1156·3	93·09
	Dry matter - - - - - - -	84·7	6·91
	Ash - - - - - - - -	9·58	·707
	Percentage of ash calculated on the dry matter,		11·301
	2. *Sheaths* - - - - - - - -	904·	
	Water - - - - - - - -	814·06	90·05
	Dry matter - - - - - - -	89·94	9·95
	Ash - - - - - - - -	10·16	1·01
	Percentage of ash calculated on the dry matter,		11·02
	3. *Leaves* - - - - - - - -	1216·	
	Water - - - - - - - -	1000·38	82·268
	Dry matter - - - - - - -	215·62	17·732
	Ash - - - - - - - -	20·66	1·699
	Percentage of ash calculated on the dry matter,		9·581
	4. *Tassels* - - - - - - - -	233·	
	Water - - - - - - - -	191·5	82·104
	Dry matter - - - - - - -	41·5	17·896
	Ash - - - - - - - -	2·16	·902
	Percentage of ash calculated on the dry matter,		5·201
	5. *Roots* - - - - - - - -	233·	
	Water - - - - - - - -	194·	83·205
	Dry matter - - - - - - -	39·	16·795
	Ash - - - - - - - -	3·58	1·503
	Percentage of ash calculated on the dry matter,		9·107

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
AUGUST 16.	Average height of corn, 72 inches. Increase in height during the last week, 7 inches, or 1 inch per day. Nearly the whole tassel is above the upper sheath, in the plant taken for proportions; length, 19 inches. Length of stalk, 46 inches. Increase in length during the last week, 24 inches, or 3½ inches per day. Two ears begin to form. Ears 3 inches long. Silks from 1 – 3 inches long. Each ear has 9 sheaths, 5 of which have leaf-blades. Length of husks, from 10 – 17 inches. Each kernel is entirely enveloped in husks of its own. Ear-stalks 1½ inches long.		
	About the average weight of each plant - -	6780·85 grs.	
	Increase in weight during the last week - -	2953·35	
	Average increase in weight per day - -	436·19	
	Average increase in weight per hour - -	18·16	
	Relation of the different parts of the plant to each other:		
	Stalk - - - - - - - -	2738·	38·343
	Sheaths - - - - - - -	1450·	20·306
	Leaves - - - - - - -	1640·	22·967
	Tassels - - - - - - -	330·2	4·624
	Sheaths of husks of 2 ears - - -	350·9	4·914
	Leaves of husks of 2 ears - - -	140·25	1·964
	Two ear-stalks - - - - -	64·	·897
	Two ears - - - - - -	67·5	·943
	Roots - - - - - - - -	360·	5·043
	Exact weight of the plant taken for proportions,	7140·85	100·
	PROPORTIONS.		
	1. *Stalk* - - - - - - - -	2738·	
	Water - - - - - - -	2496·5	91·179
	Dry matter - - - - - -	241·5	8·821
	Ash - - - - - - -	25·87	·945
	Percentage of ash calculated on the dry matter,		10·712
	2. *Sheaths* - - - - - - -	1450·	
	Water - - - - - -	1289·53	88·933
	Dry matter - - - - - -	160·47	11·067
	Ash - - - - - - -	18·58	1·281
	Percentage of ash calculated on the dry matter,		11·578

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
AUGUST 16.	3. *Leaves* - - - - - - - -	1640· grs.	
	Water - - - - - - - -	1334·2	81·353
	Dry matter - - - - - - -	305·8	18·647
	Ash - - - - - - - -	34·14	2·081
	Percentage of ash calculated on the dry matter,		11·164
	4. *Tassels* - - - - - - - -	330·2	
	Water - - - - - - - -	213·1	64·503
	Dry matter - - - - - - -	107·1	35·497
	Ash - - - - - - - -	4·95	1·041
	Percentage of ash calculated on the dry matter,		4·602
	5. *Sheaths of husks* - - - - - - -	350·9	
	Water - - - - - - - -	311·72	88·802
	Dry matter - - - - - - -	39·18	11·198
	Ash - - - - - - - -	2·27	·604
	Percentage of ash calculated on the dry matter,		6·04
	6. *Leaves of husks* - - - - - - -	140·25	
	Water - - - - - - - -	116·71	83·201
	Dry matter - - - - - - -	23·54	16·799
	Ash - - - - - - - -	1·36	·906
	Percentage of ash calculated on the dry matter,		5·707
	7. *Ear-stalks* - - - - - - - -	64·	
	Water - - - - - - - -	57·53	89·89
	Dry matter - - - - - - -	6·47	10·11
	Ash - - - - - - - -	·37	·578
	Percentage of ash calculated on dry matter -		5·718
	8. *Ears* - - - - - - - - -	67·5	
	Water - - - - - - - -	59·67	88·4
	Dry matter - - - - - - -	7·83	11·6
	Ash - - - - - - - -	·56	·829
	Percentage of ash calculated on the dry matter,		7·152
	Ash tastes decidedly of caustic potash.		
	9. *Roots* - - - - - - - - -	360·	
	Water - - - - - - - -	296·63	82·397
	Dry matter, - - - - - - -	63·37	17·603
	Ash - - - - - - - -	4·9	1·361
	Percentage of ash calculated on the dry matter,		7·732

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
AUGUST 23.	Average height of corn, 76 inches. Increase in height during the last week, 4 inches. In full flower. Silks show themselves. Stalks 59 inches long. Increase in length during the last week, 13 inches: or almost 2 inches per day. Tassel 17 inches long. The plant taken for proportions has 1 ear silked out: two others are just beginning to form.		
	About the average weight of each plant - -	8170·7 grs.	
	Increase in weight during the last week - -	1389·85	
	Average increase in weight per day - -	198·55	
	Average increase in weight per hour - -	8·27	
	Relation of the different parts of the plant to each other:		
	Tassel - - - - - - -	173·2	2·12
	Top stalk - - - - - -	1007·	12·335
	Butt stalk* - - - - - -	1489·5	18·239
	Sheaths - - - - - -	1273·5	15·596
	Leaves - - - - - - -	1540·2	18·812
	Ear-stalks - - - - - -	338·5	4·143
	Ears (each kernel is enveloped yet in its husks) - - - - - -	312·2	3·821
	Silks - - - - - - -	130·4	1·596
	Sheaths of husks - - - - -	933·2	11·421
	Leaves of husks - - - - -	379·	4·638
	Roots - - - - - - -	594·	7·279
	Weight of 1 plant - - - - -	8170·7	100·
	PROPORTIONS.		
1.	*Tassels* - - - - - - - -	173·2	
	Water - - - - - - -	119·95	69·255
	Dry matter - - - - - -	53·25	30·745
	Ash - - - - - - -	3·36	1·939
	Percentage of ash calculated on the dry matter,		6·309
2.	*Top stalk* - - - - - - -	1007·	
	Water - - - - - - -	900·25	89·399
	Dry matter - - - - - -	106·75	10·601
	Ash - - - - - - -	7.31	.726
	Percentage of ash calculated on the dry matter,		6·847
3.	*Butt stalk* - - - - - - -	1489·5	
	Water - - - - - - -	1320·	88·62
	Dry matter - - - - - -	169·5	11·38
	Ash - - - - - - -	15·43	1·036
	Percentage of ash calculated on the dry matter,		9·103

*The stalk is divided at the insertion of the upper ear.

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
AUGUST 23.	4. *Sheaths*	1273·5 grs.	
	Water	1120·	87·947
	Dry matter	153·5	12·053
	Ash	19·75	1·551
	Percentage of ash calculated on the dry matter,		12·866
	5. *Leaves*	1540·2	
	Water	1270·4	82·482
	Dry matter	269·80	17·518
	Ash	24·37	1·582
	Percentage of ash calculated on dry matter		9·032
	6. *Ear-stalks*	336·5	
	Water	315·64	93·246
	Dry matter	22·86	6·754
	Ash	1·63	·481
	Percentage of ash calculated on the dry matter,		7·13
	7. *Ears*	312·2	
	Water	284·4	91·096
	Dry matter	27·8	8·905
	Ash	1·81	·579
	Percentage of ash calculated on the dry matter,		6·511
	8. *Silks*	130·4	
	Water	120·32	92·269
	Dry matter	10·08	7·731
	Ash	·4	·306
	Percentage of ash calculated on the dry matter, Ash saline.		3·968
	9. *Sheaths of husks*	933·2	
	Water	831·33	89·083
	Dry matter	101·87	10·917
	Ash	6·1	·654
	Percentage of ash calculated on the dry matter,		5·988
	10. *Leaves of husks*	379·	
	Water	315·15	83·153
	Dry matter	63·85	16·847
	Ash	6·22	1·641
	Percentage of ash calculated on the dry matter,		9·741
	11. *Roots*	594·	
	Water	486·13	81·84
	Dry matter	107·87	18·16
	Ash	9·35	1·574
	Percentage of ash calculated on the dry matter,		8·667

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
August 23.	12. *Anthers* filled with pollen grains - - -	35· grs.	
	Water - - - - - - - -	8·70	24·857
	Dry matter - - - - - - -	26·30	75·143
	Ash - - - - - - - -	1·67	4·771
	Percentage of ash calculated on the dry matter,		6·349
	Ash tastes decidedly of caustic potash.		
August 30.	Average height of plants, about 78 inches. The increase in height during the last week is but very little. Pollen nearly all fallen. About $\frac{1}{3}$ of the bulk of each kernel protrudes from its husks. The plant taken for proportions is 83 inches high, and has 3 ears; two of which are very small, the silks having not yet appeared: the third is $8\frac{1}{2}$ inches long.		
	About the average weight of each plant - -	10580·2	
	Increase in weight during the last week - -	2409·5	
	Average increase in weight per day - -	344·21	
	Average increase in weight per hour - -	14·34	
	Stalk 78 inches long. Increase in length during the last week, 19 inches. Average increase in length per day, about $2\frac{3}{4}$ inches.		
	Relation of the different parts of the plant to each other:		
	Tassel (length 15 inches) - - -	150·6	1·363
	Top stalk (length 46 inches) - - -	1187·5	10·748
	Butt stalk (length 22 inches) - - -	2169·	19·632
	Sheaths - - - - - - - -	1561·3	14·132
	Leaves - - - - - - - -	1664·4	15·065
	Sheaths of husks - - - - -	2349·2	21·263
	Stalk of ear - - - - - -	409·1	3·703
	Ear - - - - - - - -	889·	8·047
	Silks - - - - - - - -	200·	1·81
	Roots - - - - - - - -	468·1	4·237
	Weight of one plant - - - -	11048·2	100·
	PROPORTIONS.		
	1. *Tassels* - - - - - - -	150·6	
	Water - - - - - - - -	98·98	65·724
	Dry matter - - - - - - -	51·62	34·276
	Ash - - - - - - - -	4·3	2·855
	Percentage of ash calculated on the dry matter,		8·33

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
August 30.	2. *Top stalks* - - - - - - - -	1187·5 grs.	
	Water - - - - - - - -	1009·38	85·
	Dry matter - - - - - - -	178·12	15·
	Ash - - - - - - - -	5·42	·456
	Percentage of ash calculated on the dry matter,		3·043
	3. *Butt Stalks* - - - - - - - -	2169·	
	Water - - - - - - - -	1858·75	85·696
	Dry matter - - - - - - -	310·25	14·304
	Ash - - - - - - - -	14·56	·671
	Percentage of ash calculated on the dry matter,		4·689
	4. *Sheaths* - - - - - - - -	1561·3	
	Water - - - - - - - -	1349·	86·402
	Dry matter - - - - - - -	212·3	13·598
	Ash - - - - - - - -	16·8	1·076
	Percentage of ash calculated on the dry matter,		7·913
	5. *Leaves* - - - - - - - -	1664·4	
	Water - - - - - - - -	1331·4	79·993
	Dry matter - - - - - - -	333·	20·007
	Ash - - - - - - - -	30·62	1·839
	Percentage of ash calculated on the dry matter,		9·195
	6. *Sheaths of husks* - - - - - - -	2349·2	
	Water - - - - - - - -	2067·7	87·591
	Dry matter - - - - - - -	291·5	12·409
	Ash - - - - - - - -	8·42	·358
	Percentage of ash calculated on the dry matter,		2·888
	7. *Stalks of ear* - - - - - - -	409·1	
	Water - - - - - - - -	376·24	91·967
	Dry matter - - - - - - -	32·86	8·033
	Ash - - - - - - - -	·7	·171
	Percentage of ash calculated on the dry matter,		2·13
	8. *Ears* - - - - - - - - -	889·	
	Water - - - - - - - -	812·13	91·353
	Dry matter - - - - - - -	76·87	8·647
	Ash - - - - - - - -	3·02	·339
	Percentage of ash calculated on the dry matter,		3·915
	9. *Silks* - - - - - - - - -	200·	
	Water - - - - - - - -	184·6	92·3
	Dry matter - - - - - - -	15·4	7·7
	Ash - - - - - - - -	·77	·385
	Percentage of ash calculated on the dry matter,		5·
	Ash saline, with a slight taste of caustic potash.		

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
August 30.	10. *Roots* - - - - - - - - -	468·1 grs.	
	Water - - - - - - - -	383·23	81·878
	Dry matter - - - - - - -	84·87	18·122
	Ash - - - - - - - -	4·36	·931
	Percentage of ash calculated on the dry matter,		5·137
	Relation of kernels to cob:		
	Kernels - - - - - - - -	202·65	27·566
	Cob - - - - - - - -	532·5	72·434
		735·15	100·
	PROPORTIONS.		
	1. *Kernels* - - - - - - - -		
	Water - - - - - - - -		90·8
	Dry matter - - - - - - -		9·2
	Ash - - - - - - - -		·41
	Percentage of ash calculated on the dry matter,		4·456
	Ash tastes of potash and chloride of sodium.		
	2. *Cobs* - - - - - - - - -	332·5	
	Water - - - - - - - -	299·3	80·015
	Dry matter - - - - - - -	33·2	19·985
	Ash - - - - - - - -	·79	·237
	Percentage of ash calculated on the dry matter,		2·379
	Ash tastes of chloride of sodium and potash.		
September 6.	Average height of plants, about 78 inches. Corn in early stages of milk. Plant taken for proportions is 75 inches in length: it has 2 ears, one about 5½ inches long. Kernels about ⅓ protruded from their husks, and about ⅓ grown. The other is 10 inches long: kernels ⅔ protruded from their husks, and about ⅔ grown.		
	Specific gravity of kernels - - -	0·9917	
	About the average weight of each plant -	12717·18	
	Increase in weight during the last week -	2136·98	
	Average increase in weight per day - -	305·28	
	Average increase in weight per hour - -	12·72	

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
SEPTEMBER 6.	Relation of the different parts of the plant to each other:		
	Tassel (length 14 inches) - - -	147·98 grs.	1·163
	Top stalk (length 35 inches) - - -	1128·8	8·886
	Butt stalk (length 26 inches) - - -	2084·7	16·394
	Sheaths - - - - - - -	1239·8	9·759
	Leaves - - - - - - -	1970·2	15·592
	Ear-stalks - - - - - -	1217·2	9·581
	Silks - - - - - - -	260·3	2·047
	Sheaths of husks - - - - -	2019·1	15·729
	Leaves of husks - - - - -	466·4	3·667
	Kernels of the largest ear - - -	926·8	7·297
	Cob of the largest ear - - - -	1255·9	9·885
	Weight of one plant - - - -	12717·18	100·
	PROPORTIONS.		
	1. *Tassels* - - - - - - - -	147·98	
	Water - - - - - - -	94·38	63·779
	Dry matter - - - - - -	53·6	36·221
	Ash - - - - - - -	3·39	2·297
	Percentage of ash calculated on the dry matter,		6·325
	2. *Top stalks* - - - - - - -	1128·8	
	Water - - - - - - -	913·6	80·935
	Dry matter - - - - - -	215.2	19·065
	Ash - - - - - - -	7·22	0·639
	Percentage of ash calculated on the dry matter,		3·356
	3. *Butt stalks* - - - - - - -	2084·7	
	Water - - - - - - -	1710·3	82·041
	Dry matter - - - - - -	374·4	17.959
	Ash - - - - - - -	23·66	1·135
	Percentage of ash calculated on the dry matter,		6·319
	4. *Sheaths* - - - - - - -	1239·1	
	Water - - - - - - -	1039·6	83·899
	Dry matter - - - - - -	199·5	16·101
	Ash - - - - - - -	17·7	1·428
	Percentage of ash calculated on the dry matter,		8·872
	5. *Leaves* - - - - - - - -	1970·2	
	Water - - - - - - -	1578·2	80·103
	Dry matter - - - - - -	392·	19·897
	Ash in part was accidentally lost.		

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
SEPTEMBER 6.	6. *Ear-stalks* - - - - - - - -	1217·2 grs.	
	Water - - - - - - - -	1055·8	86·74
	Dry matter - - - - - - -	161·4	13·26
	Ash - - - - - - - -	5·95	·489
	Percentage of ash calculated on the dry matter,		3·686
	7. *Silks* - - - - - - - - -	260·3	
	Water - - - - - - - -	232·3	89·243
	Dry matter - - - - - - -	28·	10·757
	Ash - - - - - - - -	1·66	·638
	Percentage of ash calculated on the dry matter,		5·929
	8. *Sheaths of husks* - - - - - - -	2019·1	
	Water - - - - - - - -	1624·25	80·444
	Dry matter - - - - - - -	394·85	19·556
	Ash - - - - - - - -	10·56	·523
	Percentage of ash calculated on the dry matter,		2·674
	9. *Leaves of husks* - - - - - - -	466·4	
	Water - - - - - - - -	363·	77·83
	Dry matter - - - - - - -	103·4	22·17
	Ash - - - - - - - -	7·73	1·657
	Percentage of ash calculated on the dry matter,		7·476
	Relation of kernels and cob to each other:		
	Kernels - - - - - - - -	926·8	42·461
	Cob - - - - - - - -	1255·9	57·539
	Weight of one ear - - - - - -	2182·7	100·
	1. *Kernels* of the largest ear - - - - -	676·8	
	Water - - - - - - - -	587·62	86·823
	Dry matter - - - - - - -	89·18	13·177
	Ash - - - - - - - -	3·31	·488
	Percentage of ash calculated on the dry matter,		3·693
	2. *Cob* of the largest ear - - - - - -	1105·9	
	Water - - - - - - - -	866·4	78·343
	Dry matter - - - - - - -	239·5	21·657
	Ash - - - - - - - -	3·91	·354
	Percentage of ash calculated on the dry matter,		1·632
	Ash tastes decidedly of caustic potash.		
	10. *Roots* - - - - - - - - -	247·2	
	Water - - - - - - - -	171·9	69·134
	Dry matter - - - - - - -	75·3	30·866
	Ash - - - - - - - -	4·52	1·828
	Percentage of ash calculated on the dry matter,		6·003

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
SEPTEMBER 13.	Corn in the advanced stage of milk. Kernels nearly full size.		
	Specific gravity of kernels, 1·055966.		
	Relation of the different parts of the plant to each other:		
	Tassels	195· grs.	2·239
	Top stalk	709·1	8·145
	Butt stalk	1842·1	21·169
	Sheaths	849·6	9·759
	Leaves	1317·2	15·139
	Stalk of ear	373·1	4·285
	Silks	98·8	1·019
	Sheaths of husk	1021·25	11·730
	Leaves of husk	53·5	·614
	Kernels of one ear	1150·	13·309
	Cob	1096·3	12·592
	Weight of one plant	8705·95	100·
	This plant is smaller than the average.		
	Relation of the kernels and cob to each other:		
	Kernels	1150·	51·195
	Cob	1096·3	48·805
	Weight of one ear	2246·3	100·
	PROPORTIONS.		
	1. *Kernels*	750·	
	Water	590·65	78·753
	Dry matter	169·35	21·247
	Ash	4·72	·629
	Percentage of ash calculated on the dry matter,		2·787
	Ash tastes decidedly of caustic potash.		
	2. *Cobs*	896·3	
	Water	683·2	76·224
	Dry matter	213·1	23·776
	Ash	3·6	·402
	Percentage of ash calculated on the dry matter,		1·689
	Ash tastes decidedly of caustic potash.		
	3. *Tassels*	195·	
	Water	126·5	64·359
	Dry matter	69·5	35·641
	Ash	5·83	2·983
	Percentage of ash calculated on the dry matter,		8·374

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
SEPTEMBER 13.	4. *Top stalks* - - - - - - - -	709·1 grs.	
	Water - - - - - - - -	568·48	80·169
	Dry matter - - - - - - -	140·62	19·831
	Ash - - - - - - - -	6·1	·86
	Percentage of ash calculated on the dry matter,		4·338
	5. *Butt stalks* - - - - - - - -	1842·1	
	Water - - - - - - - -	1493·35	81·067
	Dry matter - - - - - - -	348·75	18·933
	Ash - - - - - - - -	16·1	·879
	Percentage of ash calculated on the dry matter,		4·617
	6. *Sheaths* - - - - - - - -	849·6	
	Water - - - - - - - -	679·8	80·014
	Dry matter - - - - - - -	169·8	19·986
	Ash - - - - - - - -	15·72	1·85
	Percentage of ash calculated on the dry matter,		9·252
	7. *Leaves* - - - - - - - -	1317·2	
	Water - - - - - - - -	968·42	73·521
	Dry matter - - - - - - -	348·78	26·479
	Ash - - - - - - - -	32·1	2·437
	Percentage of ash calculated on the dry matter,		9·203
	8. *Stalk of ear* - - - - - - - -	373·1	
	Water - - - - - - - -	311·26	83·426
	Dry matter - - - - - - -	61·84	16·574
	Ash - - - - - - - -	1·86	·498
	Percentage of ash calculated on the dry matter,		3·008
	9. *Silks* - - - - - - - -	98·80	
	Water - - - - - - - -	86·5	87·551
	Dry matter - - - - - - -	12·3	12·449
	Ash - - - - - - - -	·66	·668
	Percentage of ash calculated on the dry matter,		5·366
	10. *Sheaths of husks* - - - - - -	1021·25	
	Water - - - - - - - -	812·2	79·529
	Dry matter - - - - - - -	209·05	20·471
	Ash - - - - - - - -	6·	·587
	Percentage of ash calculated on the dry matter,		2·865
	11. *Leaves of husks* - - - - - -	53·5	
	Water - - - - - - - -	38·65	72·243
	Dry matter - - - - - - -	14.85	27·757
	Ash - - - - - - - -	1·16	2·168
	Percentage of ash calculated on the dry matter,		7·811

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGES.
OCTOBER 18.	Corn ripe. The amount of water in the stalks, leaves and sheaths, has gradually decreased since the 13th of September. The kernels have gradually increased in specific gravity since their first appearance.		
	Relation of the different parts of the plant to each other:		
	Tassels - - - - - - - -	133· grs.	1·068
	Top stalk - - - - - - -	1096·	8·239
	Butt stalk - - - - - - -	2786·	22·375
	Sheaths - - - - - - - -	744·	5·975
	Leaves - - - - - - - -	1584·	12·721
	Sheaths of husks - - - - -	763·	6·126
	Stalks of ears - - - - -	299·	2·401
	Silks - - - - - - - -	81·	·651
	Roots - - - - - - - -	586·	4·465
	Kernels - - - - - - - -	3468·	27·852
	Cob - - - - - - - -	1012·	8·127
		12452·	100·
	Number of kernels on the above ear, 480.		
	Average weight of each kernel - - -	7·225	
	Specific gravity of kernels taken directly from the plant, 1·233378.		
	Specific gravity of kernels after being deprived of water, 1·2753.		
	Depriving the kernels of water, in this case, has increased their specific gravity.		
	Relation of the kernels to the cob:		
	Kernels - - - - - - - -	3468·	77·411
	Cob - - - - - - - -	1012·	22·589
		4480·	100·
	PROPORTIONS.		
	1. *Kernels* - - - - - - - -	1000·	
	Water - - - - - - - -	374·6	37·46
	Dry matter - - - - - - -	625·4	62·54
	Ash - - - - - - - -	8·06	·806
	Percentage of ash calculated on the dry matter,		1·288
	2. *Cob* - - - - - - - - -	506·	
	Water - - - - - - - -	295·	54·348
	Dry matter - - - - - - -	211·	45·652
	Ash - - - - - - - -	2·94	·581
	Percentage of ash calculated on the dry matter,		1·393
	Ash tastes decidedly of caustic potash.		

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
October 18.	It will be noticed that this corn was taken directly from the plant: this accounts for the large percentage of water.		
	3. *Tassels*	133· grs.	
	Water	54·90	41·278
	Dry matter	78·1	58·722
	Ash	9·20	6·917
	Percentage of ash calculated on the dry matter,		11·779
	4. *Top stalk*	1026·	
	Water	866·3	84·435
	Dry matter	159·7	15·565
	Ash	11·25	1·096
	Percentage of ash calculated on the dry matter,		7·044
	5. *Butt stalk*	2786·	
	Water	2425·95	87·076
	Dry matter	360·05	12·924
	Ash	26·65	·956
	Percentage of ash calculated on the dry matter,		7·124
	6. *Sheaths*	744·	
	Water	525·7	70·658
	Dry matter	218·3	29·342
	Ash	22·5	3·024
	Percentage of ash calculated on the dry matter,		10·307
	7. *Leaves*	1584·	
	Water	948·7	59·892
	Dry matter	635·3	40·108
	Ash	79·8	5·038
	Percentage of ash calculated on the dry matter,		12·561
	8. *Sheaths of husks*	763·	
	Water	529·2	69·357
	Dry matter	233·8	30·643
	Ash	13·46	1·764
	Percentage of ash calculated on the dry matter,		5·757
	9. *Ear-stalks*	399·	
	Water	354·6	88·872
	Dry matter	44·4	11·128
	Ash	1·28	·321
	Percentage of ash calculated on dry matter		2·883
	Ash slightly saline, and tastes decidedly of caustic potash.		

TIME.	OBSERVATIONS, PARTS AND PROPORTIONS.	QUANTITIES.	PERCENTAGE.
October 18.	10. *Silks* - - - - - - - - -	81· grs.	
	Water - - - - - - - -	66·4	81·975
	Dry matter - - - - - - -	14·6	18·025
	Ash - - - - - - - -	·99	1·222
	Percentage of ash calculated on the dry matter,		6·781
	Ash saline, with a slight taste of caustic potash.		
	11. *Nodes or joints of stalk* - - - - -	257·6	
	Water - - - - - - - -	216·35	83·987
	Dry matter - - - - - - -	41·25	16·013
	Ash - - - - - - - -	2·8	1·087
	Percentage of ash calculated on dry matter -		6·787
	Ash saline, with a slight taste of caustic potash.		
	12. *Roots* - - - - - - - - -	556·	
	Water - - - - - - - -	427·6	76·906
	Dry matter - - - - - - -	128·4	23·094
	Ash - - - - - - - -	5·3	·953
	Percentage of ash calculated on the dry matter,		4·128

COMPOSITION OF MAIZE OR INDIAN CORN.

The variety of corn, the analysis of which follows, is the small 8-rowed yellow corn, intermediate in size between the Canada corn and the 8-rowed white-flint. It was planted early in May, and was nearly ripe the 11th of August. It was strongly glazed at this time, and filled all the spaces upon the cob; but the chit shrank some on drying. I am particular to mention the variety examined, inasmuch as varieties differ in composition, both in the proximate elements and in the composition of the ash. Starch, in some varieties, is a very prominent element, and the phosphates in some occur in greater quantities than in others, while some varieties contain more oil than others. So during the periods of growth, the elements continually vary, and yet indian corn has a composition peculiarly its own.

I am not sure that I have obtained more than a proximate determination of the composition of this cereal; still, I have obtained many facts of some importance, which I shall proceed to lay before the reader. One of the great difficulties met with in the outset of the examination, or analysis of corn, is the want of a good ash. It is one of the most difficult of substances to burn. It is quite fusible when combustion has gone so far as to form an ash of a part of the material; and when this fusion occurs, it is better to begin anew, than to proceed farther with the matter. The ash, however, may be obtained in a perfectly white color, and free from coal, by proceeding in a certain manner. It should be burned at a low temperature, in a wide-mouthed crucible or capsule, and sufficient time be given it to consume. After the first part of the combustion, or the oil has been burnt off, it may be kept at a low red heat; but if it becomes quite red from a slight inattention,

it is very liable to end in fusion. The best mode of proceeding, when the ash begins to appear, is to remove it from the fire which is in common use, and which usually requires to be kept in a lively state while the work is going on; and then at the approach of evening, when the heat of the stove is considerably diminished, to replace it, and suffer it to remain during the night. In the morning it will be found to have made considerable progress. Proceeding in this way for a week or more, a good ash for analysis will be obtained. Another requisite is a perfectly dry state of the corn : at least, very dry corn has burnt better than that which was moist at the beginning. The same mode of procedure will be successful in wheat and its flour, or indeed in any of the cereals. Oats and barley, however, are not very difficult to burn.

1. *Analysis of the ash of the leaf of the small* 8*-rowed corn : cut August* 4.

Brisk effervescence of the ash on the addition of acids.

	Per centum.
Silica	27·375
Earthy phosphates	23·780
Carbonate of lime	0·500
Magnesia	0·365
Potash	22·825
Soda	5·845
Chlorine	1·750
Sulphuric acid	2·580
Carbonic acid	10·615
Organic matter	4·000
	99·665

2. *Analysis of the ash of the corn-leaf, cut August* 11; *the results of which may be stated as follows:*

		Per centum.
Quantity	20·000 grs.	
Silica	5·475	27·375
Phosphates of lime, iron and magnesia	4·756	23·780
Carbonate of lime	0·460	1·840
Magnesia	0·078	0·390
Potash	4·565	20·825
Soda	1·169	5·845
Chlorine	0·350	1·750
Sulphuric acid	0·516	2·580
Carbonic acid	2·123	10·615
Organic matter	0·500	2·500
Soluble silica	0·080	0·400
	20·072	97·900

3. *Analysis of the ash of the corn-sheath of the* 8-*rowed yellow corn, cut August* 11.

Calculated without carbonic acid or organic matter.

	Per centum.
Silica	20·000
Phosphates of lime, magnesia and iron	18·750
Carbonate of lime	0·900
Magnesia	0·040
Potash	24·405
Chloride of potassium	14·051
Chloride of sodium	0·469
Sulphuric acid	3·120
	81·735

4. *Analysis of the corn-stalk, cut August* 11.

Calculated without carbonic acid.

	Per centum.
Silica	6·457
Phosphates of lime, magnesia and iron	25·625
Carbonate of lime	0·600
Magnesia	0·050
Potash	40·540
Chloride of potassium	8·355
Chloride of sodium	3·430
Sulphuric acid	6·190
Organic matter	8·134
	98·881

5. *Analysis of the husks, cut August* 11.

Calculated without organic matter or carbonic acid.

	Per centum.
Silica	32·137
Phosphates of lime, magnesia and iron	29·431
Carbonate of lime	0·271
Magnesia	0·239
Potash	21·854
Soda	2·047
Chlorine	1·117
Sulphuric acid	11·117
	98·213

6. *Analysis of the cob of the same date.*

Calculated without organic matter or carbonic acid.

	Per centum.
Silex	10·768
Phosphates of the earths and iron	36·570
Lime	0·244
Magnesia	0·539
Potash	37·855
Soda	1·837
Chlorine	2·955
Sulphuric acid	9·200
	99·968

7. *Analysis of the kernels of the same date, and borne upon the same stalk and cob.*

	Per centum.
Silex	1·730
Phosphates of the earths and alkalies	52·759
Lime	trace.
Magnesia	trace.
Potash	27·357
Soda	5·796
Chlorine	4·101
Sulphuric acid	3·485
	95·228

The small quantity of ash employed in this analysis gave only feeble traces of lime and magnesia.

8. *Organic analysis of corn of the same date and stage of growth.*

	Per centum.
Starch	30·186
Sugar	4·968
Albumen	1·969
Casein	3·897
Oil	4·415
Fibrin	19·150
Dextrine	1·950
Gluten	1·795
Water	27·300
	95·630

9. *Analysis of the phosphates of the cob.*

Phosphates - - - - - - -	2·840
Soluble silica - - - - - - -	0·020
Lime - - - - - - - -	0·250
Magnesia - - - - - - -	0·579
Phosphate of peroxide of iron - - -	0·120
Phosphoric acid - - - - - -	1·871
	2·840

On consulting the proportion of inorganic or earthy matter in the cob, it will be seen that it is small; still when the question respecting the nutritive value of the cob is discussed, it is proper to take this into account. It is particularly rich in phosphates and other alkalies: so we have an additional reason for feeding the cob in conjunction with the grain.

10. *Analysis of the cuticle of the small* 8*-rowed yellow corn**.

	Per centum.
Silica - - - - - - - - -	3·000
Phosphates of the earths and iron - - -	54·200
Phosphates of the alkalies - - - -	12·100
Lime - - - - - - - - -	0·020
Magnesia - - - - - - - -	0·010
Potash - - - - - - - - -	22·570
Soda - - - - - - - - -	6·510
Sulphuric acid - - - - - -	1·400
Chlorine - - - - - - - -	none.
Carbonic acid - - - - - -	none.
	99·790

11. *Organic analysis of the dry cob of the small* 8*-rowed yellow corn: cut August* 11.

	Per centum.
Insoluble matter or fibrin - - - -	86·74
Albumen - - - - - - - -	1·94
Casein - - - - - - - - -	0·64
Dextrine or gum - - - - - -	1·21
Sugar and extract - - - - - -	7·25
Oil and resin - - - - - - -	1·00
	98·78

The amount of soluble matter in the cob exceeds what was expected when I commenced the analysis; and it may still exceed considerably what is here stated, inasmuch as it is

* Obtained by sifting out the cuticle from coarsely ground corn: hence not entirely free from the farinaceous matter.

affected by the time occupied in washing. It shows, however, that the cob is not by any means destitute of value; and that the practice of many farmers, of grinding the cob with the corn for feeding stock, is the most economical way of disposing of it. There is still another reason for the practice, namely, to increase the bulk of the food; for it is unsafe to feed concentrated nourishment to herbivorous animals. They require a bulky food, for the purpose of effecting a moderate distension of the alimentary canal; and hence if the cob was less nutritive than is here represented, it would still be the proper plan to be pursued in feeding cattle or horses, though not so necessary to the latter as to the former.

It will be observed particularly that the nitrogenous compounds amount to 2·58, and the gum, sugar, extract and oil, to 9·46; and if the 86 per centum of insoluble matter had been subjected to the action of fluids equal in solvent power to the gastric juice, this would still have been diminished some four or five per centum.

12. *Analysis of the leaves of Pennsylvania Dent corn.*

		Per centum.
Silica	9·900	49·500
Phosphates	3·300	16·500
Lime	1·297	6·485
Magnesia	0·360	1·800
Potash	3·360	16·800
Soda	0·350	1·750
Sulphuric acid	0·822	4·510
Chlorine	0·463	2·315
	19·852	99·660

13. *Analysis of the stalk of a variety mixed with the Tuscarora, White-flint and Sweet corn: cut August* 11.

Slight effervescence of the ash with acids*.

		Percentage without organic matter and carbonic acid.
Silica	2·325	12·398
Phosphates of lime, magnesia and iron	3·260	17·386
Carbonate of lime	1·250	6·663
Magnesia	0·025	0·131
Potash	8·615	45·949
Soda	0·916	4·882
Sulphuric acid	0·561	2·989
Chlorine	1·800	9·596
Organic matter and carbonic acid	1·020	
	19·772	99·994

* This variety, before ripening, was supposed to be the Pennsylvania Dent. It has the red cob of the Tuscarora, and about ¼ of the kernels were of this kind.

14. *Analysis of the ash of the sheaths of the same variety of corn.*

		Percentage without organic matter or carbonic acid.
Silica	6·205	33·326
Phosphates of lime, magnesia and iron	3·712	19·932
Lime	0·312	1·671
Magnesia	0·361	1·938
Potash	6·945	37·298
Soda	0·474	2·541
Sulphuric acid	0·399	2·137
Chlorine	0·213	1·142
Organic matter and carbonic acid	0·478	
	19·099	99·985

15. *Analysis of the ash of the husks of the mixed corn, Tuscarora Sweet and White-flint.*

	Per centum.
Silica	36·331
Earthy phosphates	18·060
Lime	1·053
Magnesia	0·205
Potash	21·061
Chloride of potassium	19·587
Soda	0·953
Sulphuric acid	1·105
Chlorine	1·316
	99·671

16. *Analysis of the ash of the kernels of the foregoing mixed corn.*

	Per centum.	Elements in one bushel.
Silica	2·417	0·333 oz.
Earthy phosphates	45·839	6·600
Potash	32·726	4·616
Soda	4·454	0·614
Lime	0·160	0·022
Magnesia	0·080	0·011
Phosphoric acid	14·330	1·977
Chlorine	none.	
Carbonic acid	none.	
Sulphuric acid	none.	
	100·006	14·173 oz.

The ash contained between four and five per centum of organic matter, [illegible] reckoned.

17. *Analysis of the ash of the cob of the same corn.*

	Per centum.
Silica	17·626
Earthy phosphates	16·140
Phosphates of the alkalies	4·693
Magnesia	0·240
Lime	0·250
Potash	29·693
Soda	8·768
Chlorine	10·212
Sulphuric acid	11·332
	98·954

The analyses of the Rocky Mountain corn, of the Pennsylvania Dent sweet corn, and of the middle size 8-rowed yellow corn, were made from crops which grew in 1847. The analyses were conducted with as much care as in any of the subsequent cases; but the ash or materials were not in a condition as pure, and free from coal as the latter. As a whole, too, there are more discrepancies in the results, especially in the grain; and greater losses were sustained, in consequence of leaving out of the determination the phosphates of the alkalies. Still I am satisfied that the general results are worthy of confidence, and hence ought not to be omitted in consequence of a loss in the analysis, which seems to be too great for a work which is conducted with care, and after the most approved modes. It is, however, mostly in the grain that these remarks apply, and it would have been easy to have supplied the losses by calculation; but the rule which has been adopted, is, to note the actual results, and to take nothing for granted, unless it has been for organic matter or carbonic acid; and these have in most instances been determined, for the purpose of confirming the accuracy of results, or for satisfying our minds as to the correctness of the whole work.

THE ROCKY MOUNTAIN CORN.

This variety has its kernels enveloped in a husk. The cob is loose and spongy. After a few years' cultivation, its husk disappears, and it differs in no important point from some one of the common varieties now under cultivation. There are two kinds of the Rocky Mountain corn. The one removed the fartherest from the cultivated varieties, has its kernels arranged on a panicle like oats.

I. ANALYSIS OF THE ROCKY MOUNTAIN CORN.

Kernels arranged on a cob or axis of growth. Grown in Cortland county, by NATHAN SALISBURY, Esq. Growth large. The crop was perfectly ripened.

1. *Stalks.*

Silica		1·375
PHOSPHATES:		
Phosphate of peroxide of iron	2·375	
Lime	0·719	
Magnesia	0·060	
Silicic acid	1·250	
Phosphoric acid	3·875	
		7·275
Lime		1·142
Magnesia		0·175
Potash		52·977
Soda		4·713
Chlorine		0·869
Sulphuric acid		0·361
Carbonic acid		26·000
Organic matter		2·235
		98·132 S.

2. *Leaves and sheaths.*

Silica		14·000
PHOSPHATES:		
Phosphate of peroxide of iron	3·125	
Lime	4·216	
Magnesia	0·075	
Silicic acid	8·350	
Phosphoric acid	5·684	
		21·450
Lime		5·145
Magnesia		2·080
Potash		39·124
Soda		3·152
Chlorine		0·555
Sulphuric acid		0·652
Carbonic acid		10·000
Organic matter		3·450
		99·608 S.

3. *Cobs and husks of the kernels.*

Silica		11·950
PHOSPHATES:		
Phosphate of peroxide of iron	6·650	
Lime	2·058	
Magnesia	0·410	
Silicic acid	0·350	
Phosphoric acid	9·482	
		18·950
Lime		0·140
Magnesia		0·270
Potash		52·060
Soda		9·202
Chlorine		3·034
Sulphuric acid		0·722
Chloride of sodium		
Carbonic acid		trace.
Organic matter		2·100
Coal		
		98·428 S.

4. *Kernels.*

Silica		3·050
PHOSPHATES:		
Phosphate of peroxide of iron	1·450	
Lime	5·358	
Magnesia	14·650	
Silicic acid	trace.	
Phosphoric acid	20·692	
		42·150
Lime		0·085
Magnesia		0·050
Potash		24·350
Soda		3·394
Chlorine		
Sulphuric acid		1·210
Chloride of sodium		1·020
Carbonic acid		trace.
Organic matter		6·500
Coal		11·650
		93·459 S.

II. ANALYSIS OF THE PENNSYLVANIA DENT CORN.

The plant had just past its period of flowering. Grown upon Mr. BEMENT's farm, Albany county. Soil a sandy loam.

1. *Leaves and sheaths.*

Silicic acid		53·450
PHOSPHATES:		
Phosphate of peroxide of iron	0·350	
Lime	1·466	
Magnesia	0·150	
Silicic acid	0·250	
Phosphoric acid	12·184	
		14·400
Lime		3·468
Magnesia		0·320
Potash		12·335
Soda		5·860
Chloride of sodium		5·450
Sulphuric acid		0·670
Carbonic acid		trace.
Organic matter		1·050
		97·003 S.

2. *Stalks*, of the same date as the leaves.

From BEMENT's 3-hill farm. Soil a sandy loam. Growth very large.

Silica		2·385
PHOSPHATES:		
Phosphate of peroxide of iron	0·625	
Lime	3·497	
Magnesia	0·075	
Silicic acid	5·075	
Phosphoric acid	19·785	
		29·075
Lime		2·025
Magnesia		trace.
Potash		44·943
Soda		0·005
Chloride of sodium		10·190
Sulphuric acid		0·283
Carbonic acid		trace.
Organic matter		9·750
		98 S.

3. *Husks of the same corn.*

Silica		21·000
PHOSPHATES:		
Phosphate of peroxide of iron	3·500	
Lime	6·092	
Magnesia	0·200	
Silicic acid	0·700	
Phosphoric acid	26·608	
		37·608
Lime		0·280
Magnesia		0·600
Potash		27·860
Soda		9·400
Chloride of sodium		0·043
Sulphuric acid		1·244
Carbonic acid		trace.
Organic matter		4·200
		100·727 S.

4. *Cobs of the same corn.*

Silica		5·200
PHOSPHATES:		
Phosphate of peroxide of iron	0·300	
Lime	4·680	
Magnesia	0·700	
Silicic acid	6·500	
Phosphoric acid	4·220	
		10·400
Lime		0·160
Magnesia		trace.
Potash		38·332
Soda		21·844
Chloride of sodium		2·350
Sulphuric acid		0·688
Carbonic acid		14·760
Organic matter		4·900
		98·734 S.

5. *Young soft kernels of Pennsylvania Dent corn.* 1·950

Silica	1·450	
Phosphates:		
Phosphate of peroxide of iron	0·994	
Lime	12·298	
Magnesia	0·650	
Silicic acid	16·706	
Phosphoric acid	5·382	
Soda	0·695	
		38·665
Potash		0·141
Lime		9·649
Magnesia		14·258
Potash		10·113
Soda		9·208
Chloride of sodium		0·326
Sulphuric acid		trace.
Carbonic acid		20·657
Organic matter and loss		100·000 S.

6. *Stalks and leaves of the Pennsylvania Dent corn, cut June 11.* 14 inches high, but grew in a shaded place. 9·909

Silica	2·500	
Phosphates:		
Phosphate of peroxide of iron	4·456	
Lime	0·400	
Magnesia	trace.	
Silica	11·644	
Phosphoric acid		19·000
Lime		2·256
Magnesia		trace.
Potash		25·480
Soda		4·607
Chloride of sodium		8·983
Sulphuric acid		1·976
Organic matter		13·200
		98·221 S.

	Proportions.	Per centum.
Water		92·660
Dry stalks, etc.		7·360
Ash		1·440
Ash calculated dry		19·512

III. ANALYSIS OF SWEET CORN.

1. *Stalk, cut below the ears.*

Plant in blossom. Soil a clay loam.

Silica		3·100
PHOSPHATES:		
Phosphate of peroxide of iron	0·300	
Lime	2·651	
Magnesia	0·200	
Silicic acid	4·300	
Phosphoric acid	22·049	
		29·500
Lime		0·169
Magnesia		0·150
Potash		44·912
Soda		5·302
Chlorine		1·089
Sulphuric acid		11·885
Carbonic acid		trace.
Organic matter		5·200
		101·307 S.

PROPORTIONS.

Per centum of water	81·840
Dry stalks	18·160
Ash	0·660
Ash calculated dry	3·634

2. *Stalks cut above the ear.*

Silica		1·000
PHOSPHATES:		
Phosphate of peroxide of iron	4·600	
Lime	0·423	
Magnesia	0·015	
Silicic acid	3·800	
Phosphoric acid	27·462	
		36·300
Lime		0·344
Magnesia		0·015
Potash		19·682
Soda		31·589
Chlorine		4·736
Sulphuric acid		1·516
Carbonic acid		trace.
Organic matter		4·500
		99·721 S.

	Proportions.	Per centum.
Water		91·660
Dry		8·340
Ash		0·680
Calculated dry		8·153

3. *Sheaths of the same corn, cut August 6 : in flower.*

Silica		16·100
Phosphates:		
Phosphate of peroxide of iron	1·000	
Lime	1·579	
Magnesia	4·800	
Silicic acid	5·100	
Phosphoric acid	12·621	
		25·100
Lime		2·707
Magnesia		0·900
Soda		0·406
Potash		31·881
Chloride of sodium		7·883
Sulphuric acid		lost.
Carbonic acid		trace.
Organic matter		4·000
		92·633 S.

	Proportions.	Per centum.
Water		79·130
Dry		20·870
Ash		1·360
Ash calculated dry		6·516

4. *Leaves of sweet corn, cut while in blossom, August 6, 1847.*

Silica		19·700
Phosphates:		
Phosphate of peroxide of iron	3·100	
Lime	8·010	
Magnesia	2·920	
Silica	5·500	
Phosphoric acid	14·370	
		33·900
		53·600

Carried forward

Brought forward		53·600
Lime		2·538
Magnesia		4·480
Potash		17·712
Soda		12·645
Chloride of sodium		2·451
Sulphuric acid		
Carbonic acid		trace.
Organic matter		
		93·426 S.

PROPORTIONS.	Per centum.
Water	65·820
Dry	34·180
Ash	2·880
Ash calculated dry	8·431

5. *Tassels of sweet corn, cut August* 6, 1847.

Silica		17·800
PHOSPHATES:		
Phosphate of peroxide of iron	2·600	
Lime	1·804	
Magnesia	5·440	
Silica	trace.	
Phosphoric acid	4·956	
		14·800
Lime		3·158
Magnesia		0·400
Potash		19·484
Soda		12·118
Chloride of sodium		7·528
Sulphuric acid		
Carbonic acid		trace.
Organic matter		11·304
		86·592 S.

PROPORTIONS.	Per centum.
Water	67·750
Dry	32·250
Ash	1·900
Calculated dry	5·891

IV. ANALYSIS OF MIDDLE-SIZED 8-ROWED YELLOW CORN.

Cut August 6. Just out of flower.

1. *Sheaths.*

Silica		31·300
PHOSPHATES:		
Phosphate of peroxide of iron	1·900	
Lime	3·384	
Magnesia	1·840	
Silica	0·500	
Phosphoric acid	6·876	
		14·500
Lime		2·989
Magnesia		5·920
Potash		30·363
Soda		2·499
Chloride of sodium		4·738
Sulphuric acid		
Carbonic acid		trace.
Organic matter		
		92·139 S.

PROPORTIONS.	Per centum.
Water	82·730
Dry	17·270
Ash	2·200
Ash calculated dry	12·738

2. *Stalk of the middle-sized* 8*-rowed yellow corn, cut below the ear.*

Silica		8·950
PHOSPHATES:		
Phosphate of peroxide of iron	0·300	
Lime	1·144	
Magnesia	0·100	
Silica	0·350	
Phosphoric acid, potash and soda	17·406	
		19·300
Lime		3·187
Magnesia		trace.
Potash		41·623
Soda		7·726
Chloride of sodium		4·943
Sulphuric acid		12·475
Carbonic acid		trace.
Organic matter		2·797

PROPORTIONS.	Per centum.
Water	81·220
Dry stalks	18·780
Ash	0·420
Ash calculated dry	2·236

3. *Husks of the 8-rowed yellow corn.*

Silica		23·000
PHOSPHATES:		
Phosphate of peroxide of iron	trace.	
Lime	3·271	
Magnesia	0·150	
Silica	3·910	
Phosphoric acid	18·569	
		25·900
Lime		1·353
Magnesia		0·800
Potash		14·267
Soda		19·267
Chloride of sodium		3·145
Sulphuric acid		5·001
Carbonic acid		4·765
Organic matter		3·456
		100·745 S.

PROPORTIONS.	Per centum.
Water	74·490
Dry	25·550
Ash	0·810
Calculated dry	3·175

Proportions of elements in the tassels of the same corn.

	Per centum.
Water	56·500
Dry	43·500
Ash	2·780
Ash calculated dry	6·393

4. Stalks above the ear.

Silica		19·600
PHOSPHATES:		
Phosphate of peroxide of iron	6·100	
Lime	10·943	
Magnesia	0·800	
Silica	1·000	
Phosphoric acid	14·657	
		33·500
Lime		3·215
Magnesia		0·100
Potash		20·874
Soda		17·047
Chloride of sodium		8·603
Sulphuric acid		2·329
Carbonic acid		trace.
Organic matter		
		105·268 S.

PROPORTIONS.	Per centum.
Water	78·840
Dry	21·160
Ash	0·680
Calculated dry	2·741

5. Leaves of the same corn.

Silica		37·550
PHOSPHATES:		
Phosphate of peroxide of iron	8·800	
Lime	6·289	
Magnesia	trace.	
Silica	2·350	
Phosphoric acid	7·210	
		24·649
Lime		6·133
Magnesia		2·820
Potash		18·660
Soda		8·860
Chloride of sodium		0·838
Sulphuric acid		1·030
Carbonic acid		
Organic matter		

PROPORTIONS.

	Per centum.
Water	80·750
Dry	19·250
Ash	2·800
Calculated dry	14·545

INORGANIC ANALYSES OF THE SEVERAL PARTS OF THE PLANTS OF THE EARLY WHITE FLINT CORN, AT DIFFERENT STAGES OF THEIR GROWTH.

The dates on which the plants were taken for analysis, correspond with those on which they were taken for proportions. I have hence, to save repetition, omitted to give descriptions of the stage of advancement of the plants with the following analyses, as these are given in full in connection with the proportions, and can be easily referred to.

It would have been desirable to have made this series of analyses more complete; but the plant was divided into so many parts, that it was quite impossible for one to do it, and carry on organic analyses of the same parts at the same time. Considerable, however, has been done. The analyses were conducted during several successive weeks, when the plants were growing most vigorously. They were also analyzed after they had ripened their grain. The roots were freed of foreign matter, by washing them carefully in cold water. The potash was obtained with bichloride of platinum. It is proper to state this here, inasmuch as by this process less potash has been obtained, and of course more soda than by absolute alcohol. Both methods have been followed at different times; but in this series, the bichloride of platinum has been exclusively resorted to for separating the two alkalies.

JULY 12.

1. *Leaves* (Description of plant on page 173).

Carbonic acid	7·50
Silicic acid	13·30
Sulphuric acid	2·06
Phosphates	22·00
Lime	0·68
Magnesia	0·27
Potash	9·88
Soda	32·17
Chlorine	5·08
Organic matter	4·60
	98·54 S.

2. *Sheaths* (Owing to an error in obtaining the chlorine and sulphuric acid, this analysis is incomplete).

Carbonic acid	5·20
Silicic acid	8·30
Phosphates	10·50
Lime	5·76
Magnesia	2·52
Potash	13·39
Soda	29·68
Chlorine, sulphuric acid, organic matter and loss,	26·65
	100·00 S.

I can not account for the small percentage of silicic acid in the above analysis. It is much less than was obtained either the preceding or the succeeding weeks.

AUGUST 2.

1. *Leaves* (Description of plant on page 176).

Carbonic acid	2·850
Silicic acid	19·850
Sulphuric acid	1·995
Phosphates	16·250
Lime	4·035
Magnesia	2·980
Potash	11·675
Soda	29·590
Chlorine	6·020
Organic acids	2·400
	97·645 S.

2. *Sheaths.*

Carbonic acid	9·60
Silicic acid	16·30
Sulphuric acid	3·64
Phosphates	8·90
Lime	3·27
Magnesia	2·45
Potash	10·46
Soda	33·60
Chlorine	8·68
Organic acids	2·80
	99·65 S.

3. *Stalks.*

Carbonic acid	13·40	
Silicic acid	2·50	
Sulphuric acid	3·18	
Phosphates	11·50	
Lime	3·82	
Magnesia	3·60	
Potash	12·35	
Soda	35·09	
Chlorine	7·21	
Organic acids	4·85	
	97·50	S.

The two following analyses are not completed, there being too small a quantity of ash.

4. *Tassels.*

Carbonic acid	2·40	
Silicic acid	2·00	
Phosphates	21·67	
Lime	1·50	
Magnesia	0·67	
Potash	10·70	
Soda	37·77	
Sulphuric acid		
Chlorine, organic matter and loss	23·29	
	100·00	S.

5. *Roots.*

Silicic acid	16·916	
Phosphates	14·160	
Lime	2·634	
Magnesia	1·433	
Potash	8·950	
Soda	31·700	
Carbonic acid, sulphuric acid, chlorine, organic matter and loss	24·207	
	100·000	S.

AUGUST 9.

1. *Leaves* (Description of plant on page 177).

Carbonic acid	1·200
Silicic acid	24·750
Sulphuric acid	2·475
Phosphates	16·900
Lime	4·365
Magnesia	3·400
Potash	8·240
Soda	26·690
Chlorine	6·700
Organic acids	2·025
	97·750 S.

2. *Sheaths.*

Carbonic acid	4·95
Silicic acid	14·80
Sulphuric acid	3·75
Phosphates	13·15
Lime	3·27
Magnesia	5·10
Potash	8·21
Soda	33·04
Chlorine	7·21
Organic acids	5·70
	93·08 S.

3. *Stalks.*

Carbonic acid	13·50
Silicic acid	2·90
Sulphuric acid	2·15
Phosphates	11·80
Lime	4·67
Magnesia	2·72
Potash	10·88
Soda	29·66
Chlorine	14·90
Organic acids	4·65
	97·63 S.

4. *Tassels* (The following analysis is incomplete).

Carbonic acid	2·892
Silicic acid	1·335
Phosphates	20·248
Lime	0·445
Magnesia	0·445
Potash	11·081
Soda	39·494
Chlorine, sulphuric acid, organic matter and loss,	24·060
	100·000 S.

AUGUST 16.

1. *Leaves* (Description of plant on page 179).

Carbonic acid	3·025
Silicic acid	21·100
Sulphuric acid	6·220
Phosphates	14·650
Lime	5·347
Magnesia	1·510
Potash	10·179
Soda	31·390
Chlorine	1·975
Organic acids	2·800
	98·187 S.

2. *Sheaths.*

Carbonic acid	2·60
Silicic acid	18·20
Sulphuric acid	3·01
Phosphates	11·20
Lime	0·62
Magnesia	1·02
Potash	10·73
Soda	32·62
Chlorine	16·42
Organic acids	3·25
	99·67 S.

3. *Stalks.*

Carbonic acid	12·06
Silicic acid	4·70
Sulphuric acid	5·91
Phosphates	11·29
Lime	2·82
Magnesia	1·73
Potash	10·31
Soda	35·54
Chlorine	9·03
Organic acids	4·40
	97·69 S.

AUGUST 28.

1. *Leaves* (Description of plant on page 181).

Carbonic acid	0·65
Silicic acid	34·90
Sulphuric acid	4·92
Phosphates	17·00
Lime	2·08
Magnesia	1·59
Potash	10·85
Soda	21·23
Chlorine	3·06
Organic acids	3·38
	99·66 S.

2. *Sheaths.*

Carbonic acid	4·82
Silicic acid	23·70
Sulphuric acid	4·26
Phosphates	12·70
Lime	1·13
Magnesia	2·16
Potash	5·21
Soda	33·44
Chlorine	4·69
Organic acids	5·00

3. *Butt stalk.*

Carbonic acid	4·99
Silicic acid	6·20
Sulphuric acid	5·53
Phosphates	17·30
Lime	1·69
Magnesia	2·23
Potash	10·85
Soda	33·21
Chlorine	10·16
Organic acids	5·50
	97·66 S.

4. *Top stalk.*

Carbonic acid	3·10
Silicic acid	10·80
Sulphuric acid	6·88
Phosphates	25·60
Lime	1·18
Magnesia	0·84
Potash	12·36
Soda	27·48
Chlorine	4·74
Organic matter	5·40
	98·38 S.

5. *Tassel* (The four following analyses are not complete : the carbonic and sulphuric acids, chlorine and organic matter, were not determined ; the rest were accurately obtained).

Silicic acid	23·00
Phosphates	20·40
Lime	1·14
Magnesia	1·60
Potash	6·10
Soda	25·12
Carbonic acid, sulphuric acid, chlorine, organic matter and loss	22·64
	100·00 S.

6. *Leaves of husks.*

Silicic acid	25·40
Phosphates	15·80
Lime	0·66
Magnesia	0·60
Potash	6·80
Soda	29·12
Carbonic acid, sulphuric acid, chlorine, organic matter and loss	22·72
	100·00 S.

7. *Sheaths of husks.*

Silicic acid	15·80
Phosphates	17·60
Lime	0·46
Magnesia	0·40
Potash	6·66
Soda	32·84
Carbonic acid, sulphuric acid, chlorine, organic matter and loss	26·34
	100·00 S.

8. *Roots.*

Silicic acid	33·26
Phosphates	17·38
Lime	0·56
Magnesia	0·75
Potash	6·94
Soda	22·16
Carbonic acid, sulphuric acid, chlorine, organic matter and loss	18·96
	100·00 S.

AUGUST 30.

At this date, for want of time, only the leaves and sheaths have been analyzed. Description of plant on page 183.

1. *Leaves of the stalk and husks.*

Carbonic acid	3·50
Silicic acid	36·27
Sulphuric acid	5·84
Phosphates	13·50
Lime	3·38
Magnesia	2·38
Potash	9·15
Soda	22·13
Chlorine	1·63
Organic matter	2·05
	90·83 S.

3. *Sheaths of the stalks and husks.*

Silicic acid	38·10
Sulphuric acid	6·36
Phosphates	12·80
Lime	1·20
Magnesia	2·02
Potash	7·76
Soda	19·68
Chlorine	4·34
Organic matter	3·40
Carbonic acid	4·14
	99·86 S.

SEPTEMBER 13.

At this period, only the stalks and sheaths were examined. For proportions and description of corn at this date, refer to page 188.

1. *Stalks.*

Carbonic acid	0·35
Silicic acid	10·90
Sulphuric acid	14·02
Phosphates	13·45
Lime	2·70
Magnesia	1·58
Potash	19·22
Soda	26·22
Chlorine	3·80
Organic acids	3·50

2. *Sheaths.*

Carbonic acid	4·195
Silicic acid	45·260
Sulphuric acid	2·406
Phosphates	10·150
Lime	1·803
Magnesia	1·300
Potash	11·115
Soda	17·799
Chlorine	2·365
Organic acids	2·450
	98·893 S.

OCTOBER 18.

Corn ripe. For proportions and further description of plants at this date, refer to page 190.

1. *Stalks.*

Carbonic acid	1·850
Silicic acid	12·850
Sulphuric acid	10·793
Phosphates	15·150
Lime	2·890
Magnesia	0·936
Potash	16·210
Soda	24·699
Chlorine	10·963
Organic acids	3·200
	99·461 S.

2. *Sheaths.*

Carbonic acid	trace.
Silicic acid	51·250
Sulphuric acid	12·270
Phosphates	9·760
Lime	2·139
Magnesia	0·792
Potash	7·488
Soda	12·449
Chlorine	2·960
Organic acids	trace.

3. *Sheaths of husks.*

Carbonic acid	trace.
Silicic acid	47·650
Sulphuric acid	6·674
Phosphates	26·250
Lime	0·450
Magnesia	0·072
Potash	3·512
Soda	9·832
Chlorine, organic acids and loss	5·560
	100·000 S.

4. *Leaves.*

Carbonic acid	4·050
Silicic acid	58·650
Sulphuric acid	4·881
Phosphates	5·850
Lime	4·510
Magnesia	0·864
Potash	7·333
Soda	8·520
Chlorine	2·664
Organic acids	2·200
	99·342 S.

5. *Tassels* (The two following analyses are not complete).

Silicic acid	61·056
Phosphates	9·833
Lime	2·349
Magnesia	0·640
Potash	6·861
Soda	8·899
Carbonic and sulphuric acids, chlorine, organic matter and loss	10·362
	100·000 S.

6. *Roots.*

Silicic acid	23·608
Phosphates	11·856
Lime	4·666
Magnesia	1·039
Potash	11·334
Soda	25·450
Carbonic and sulphuric acids, chlorine, organic acids and loss	22·038
	100·000 S.

PROXIMATE ORGANIC ANALYSIS OF THE SEVERAL PARTS OF THE EARLY WHITE-FLINT CORN.

AUGUST 2.

(For a description of the stage of growth, refer to page 176.)

1. *Stalk.* A transverse section was taken from between the nodes near its base. 100 grs. gave of

		Calculated without the water.
Starch	trace.	
Sugar and extractive matter soluble in alcohol and water, mostly sugar, 1·31 grs.; insoluble in alcohol, 0·36 grs.	1·670	41·666
Fibre and chlorophyll	0·095	2·400
Fibre	1·400	35·363
Matter dissolved out of fibre by a weak solution of potash: resembles albumen	0·536	13·510
Albumen	0·125	3·157
Casein	trace.	
Dextrine or gum	0·155	3·914
	3·980	100·000
Water	95·030	
	99·010 S.	

2. *Sheaths.* 109 grs. gave of

		Calculated without the water.
Starch	none.	
Sugar and extractive matter soluble in alcohol, 1·65; insoluble, 0·24	1·890	25·233
Fibre with chlorophyll	0·245	3·257
Fibre	3·290	43·672
Matter dissolved out of fibre by a weak solution of caustic potash: resembles albumen,	1·120	14·861
Albumen	0·210	2·793
Casein	0·180	2·395
Dextrine or gum	0·585	7·789
	7·520	100·000
Water	91·485	
	99·005 S.	

3. *Leaves.* 100 grs. gave of

		Calculated without the water.
Starch	none.	
Sugar and extractive matter soluble in alcohol, mostly sugar, 1·11; insoluble in alcohol, 1·89	3·000	19·961
Fibre with a little chlorophyll	1·390	9·248
Fibre	8·620	57·352
Matter separated from the fibre by a weak solution of caustic potash : resembles albumen	0·290	1·929
Albumen	trace.	
Casein	0·730	4·857
Dextrine or gum	0·850	5·655
Oil and wax	0·150	0·998
	15·030	100·000
Water	86·782	
	100·812 S.	

4. *Tassels.*

		Calculated without the water.
Sugar and extractive matter soluble in alcohol, 0·70; insoluble, 2·10	2·800	34·272
Fibre with a little chlorophyll and starch	0·670	8·201
Fibre	1·830	22·398
Matter separated from fibre by digesting severally in alcohol and a weak solution of caustic potash : oil, wax and albumen	1·520	18·605
Albumen	0·420	5·141
Casein	trace.	
Dextrine or gum	0·930	11·383
	8·170	100·000
Water	90·379	
	98·549 S.	

AUGUST 23.

(For description of the plant at this date, refer to page 181.)

1. *Butt stalk.* A transverse section was taken from between the 3d and 4th nodes.

		Calculated without the water.
Starch - - - - - - - -	mere trace.	
Sugar and extractive matter, mostly sugar -	3·090	32·543
Fibre with a little chlorophyll - - -	0·295	3·106
Fibre - - - - - - - -	4·200	44·234
Matter separated from fibre by a weak solution of caustic potash: resembles albumen,	1·160	12·218
Albumen - - - - - - - -	0·015	0·158
Casein - - - - - - - -	0·240	2·528
Dextrine - - - - - - - -	0·495	5·213
	9·495	100·000
Water - - - - - - - -	88·620	
	98·115 S.	

2. *Top stalk.* A transverse section was taken from between the 5th and 6th nodes.

		Calculated without the water.
Sugar and extractive matter, mostly sugar -	2·175	31·224
Fibre with a little chlorophyll - - -	0·445	6·389
Fibre - - - - - - - -	2·925	41·997
Matter dissolved out of fibre by a weak solution of caustic potash: resembles albumen,	0·825	11·846
Albumen - - - - - - - -	0·075	1·077
Casein - - - - - - - -	0·060	0·862
Dextrine - - - - - - - -	0·460	6·605
	6·695	100·000
Water - - - - - - - -	92·399	
	99·094 S.	

3. *Tassels.*

		Calculated without the water.
Sugar and extractive matter soluble in alcohol, 3·08; insoluble in alcohol, 4·46 - -	7·540	26·490
Fibre with a little chlorophyll and starch -	7·640	26·852
Fibre, oil and wax - - - - - -	7·250	25·468
Matter dissolved out of fibre by a weak solution of caustic potash : albumen - -	4·260	14·958
Albumen - - - - - - - -	0·110	0·365
Casein - - - - - - - -	0·150	0·526
Dextrine - - - - - - - -	1·510	5·331
	28·460	100·000
Water - - - - - - - -	69·255	
	97·715 S.	

4. *Sheaths.*

		Calculated without the water.
Sugar and extractive matter, mostly sugar -	3·190	28·687
Fibre with a little chlorophyll - - -	0·540	4·856
Fibre - - - - - - - -	4·780	42·985
Oil and wax - - - - - -	0·150	1·348
Matter dissolved out of fibre by a weak solution of potash : resembles albumen - -	1·770	15·927
Albumen - - - - - - - -	0·020	0·179
Casein - - - - - - - -	0·010	0·090
Dextrine - - - - - - - -	0·660	5·928
	11·120	100·000
Water - - - - - - - -	87·947	
	99·067 S.	

5. *Leaves.*

		Calculated without the water.
Sugar and extractive matter - - -	3·300	18·856
Fibre with a little chlorophyll - - -	3·350	19·142
Fibre - - - - - - - -	6·950	39·720
Matter dissolved out of fibre by a weak solution of caustic potash : resembles albumen,	2·380	13·600
Albumen - - - - - - - -	0·020	0·113
Casein - - - - - - - -	0·100	0·571
Dextrine - - - - - - - -	1·270	7·256
Oil and wax - - - - - -	0·139	0·742
	17·500	100·000
Water - - - - - - - -	82·482	
	99·982 S.	

6. *Sheaths of husks.*

		Calculated without the water.
Sugar and extractive matter soluble in alcohol, mostly sugar, 3·78; insoluble, 0·87 -	4·650	50·434
Fibre with a little chloropyhll - - -	0·280	3·037
Fibre - - - - - - - -	1·880	20·391
Matter dissolved out of fibre by a weak solution of caustic potash : albumen - -	1·870	20·282
Albumen - - - - - - - -	0·200	2·160
Casein - - - - - - - -	0·010	0·108
Dextrine - - - - - - - -	0·210	2·278
Oil and wax - - - - - -	0·120	1·301
	9·220	100·000
Water - - - - - - - -	89·083	
	98·303 S.	

7. *Silks.*

		Calculated without the water.
Sugar and extractive matter soluble in alcohol, mostly sugar, 1·974; insol. in alcohol, 2·4,	4·374	54·964
Fibre with a trace of starch and a little chlorophyll - - - - - - - -	0·860	10·806
Fibre - - - - - - - -	1·266	15·909
Matter dissolved out of fibre by a weak solution of caustic potash : resembles albumen,	0·846	10·631
Albumen - - - - - - - -	0·006	0·076
Casein - - - - - - - -	0·226	2·839
Dextrine - - - - - - - -	0·380	4·775
	7·958	100·000
Water - - - - - - - -	92·269	
	100·227 S.	

8. *Ears.* Each kernel is yet enveloped in its husks.

		Calculated without the water.
Sugar and extractive matter soluble in alcohol, mostly sugar, 4·133; insoluble in alcohol, 0·707 - - - - - - - -	4·840	59·827
Fibre with a little starch - - - -	0·606	7·491
Fibre - - - - - - - -	1·006	12·435
Matter dissolved out of fibre by a weak solution of caustic potash - - - -	1·186	14·660
Albumen - - - - - - - -	0·086	1·063
Casein - - - - - - - -	trace.	
Dextrine - - - - - - - -	0·366	4·524
	8·090	100·000
Water - - - - - - - -	91·095	

SEPTEMBER 6.

Kernels about two-thirds protruded from their husks, and about two-thirds grown. For a description of the plant at this date, refer to page 185. A proximate organic analysis was only made of the kernels and cob.

1. *Kernels.*

		Calculated without the water.
Sugar and extractive matter, mostly sugar	7·60	39·015
Starch	8·06	41·376
Fibre or epidermis, and oil	1·24	6·366
Matter dissolved out of epidermis by a weak solution of caustic potash : resembles albumen	1·48	7·597
Albumen	0·69	3·542
Casein	0·05	0·256
Dextrine	0·36	1·848
	19·48	100·000
Water	80·43	
	99·91 S.	

Ether dissolved out of 100 grs. of fresh kernels, 2·64 grs. of oil, and a sweetish matter, probably sugar, which was taken up by the water in the corn.

2. *Cob.*

		Calculated without the water.
Sugar and extractive matter, mostly sugar	5·46	34.340
Starch	0·08	0·503
Dextrine or gum	0·76	4·779
Fibre and resin	5·94	37·359
Matter dissolved out of fibre by a weak solution of caustic potash : resembles albumen,	1·50	9·434
Albumen	1·52	9·560
Casein	0·62	4·025
	15·90	100·000
Water	82·41	
	98·31 S.	

SEPTEMBER 13.

Corn in advanced stage of milk. Kernels nearly full size. For proportions and specific gravity of kernels, refer to page 188.

PROXIMATE ORGANIC ANALYSIS OF THE KERNELS AND COB.

1. *Kernels.*

		Calculated without the water.
Sugar and extractive matter, mostly sugar	5·100	25·053
Starch	9·755	47·861
Fibre or epidermis, and oil	2·435	11·966
Matter dissolved out of epidermis by a weak solution of caustic potash : resembles albumen	1·530	7·523
Albumen	0·845	4·149
Casein	0·040	0·196
Dextrine or gum	0·660	3·251
	20·365	100·000
Water	78·753	
	99·118 S.	

2. *Cob.*

		Calculated without the water.
Sugar and extractive matter, mostly sugar	7·34	23·724
Starch	0·06	0·193
Fibre and resin	15·39	49·742
Matter dissolved out of fibre by a weak solution of caustic potash : resembles albumen,	6·45	20·847
Albumen	1·21	3·911
Casein	0·05	0·161
Dextrine or gum	0·43	1·422
	30·94	100·000
Water	69·45	
	100·39 S.	

OCTOBER 18.

Corn ripe. For proportions, and specific gravity of kernels, refer to page 190.

PROXIMATE ORGANIC ANALYSIS OF THE KERNELS AND COB.

1. *Kernels.*

		Calculated without the water.
Oil	3·60	3·896
Zein or gluten	1·68	1·818
Starch	59·30	64·169
Sugar and extractive matter	13·32	14·415
Fibre or epidermis	0·89	0·964
Matter dissolved out of fibre by a weak solution of caustic potash : resembles albumen,	5·99	6·482
Albumen	4·29	4·642
Casein	0·08	0·086
Dextrine or gum	3·26	3·528
	92·41	100·000
Water	8·45	
	100·86 S.	

2. *Cob.*

		Calculated without the water.
Sugar and extractive matter	4·700	6·791
Starch	trace.	
Fibre	44·188	63·845
Matter dissolved out of fibre by a weak solution of caustic potash : resembles albumen,	15·712	22·702
Albumen	0·525	0·759
Casein	0·100	0·144
Dextrine or gum	0·800	1·155
Resins	0·625	0·903
Matter dissolved out of bodies insoluble in water, by boiling alcohol	2·562	3·701
	69·212	100·000
Water	31·320	
	100·532 S.	

OCTOBER 5.

The corneous portion of the kernels is quite firm, or glazed, as it is called. The amylaceous part around the chit is yet soft and milky. At this stage, the kernels burn into a white ash much more readily than when ripe.

Composition of the ash of the kernels.

Carbonic acid	trace.
Silicic acid	0·900
Phosphoric acid, with a little peroxide of iron	50·010
Lime	0·075
Magnesia	4·240
Potash	28·405
Soda	11·840
Sodium	0·345
Chlorine	0·520
Sulphuric acid	1·240
Organic acids	2·100
	99·675 S.

OCTOBER 18.

Corn ripe.

Composition of the ash of the kernels.

Carbonic acid	trace.
Silicic acid	0·850
Phosphoric acid, with a little peroxide of iron,	60·310
Lime	0·075
Magnesia	6·500
Potash	23·175
Soda	3·605
Sodium	0·160
Chlorine	0·295
Sulphuric acid	0·515
Organic acids	5·700
	99·175 S.

Composition of the soil on which the plants of the Early White-flint corn were grown (Yard back of the Old State House).

Water	6·205
Organic matter	4·750
Silex	82·620
Alumina and peroxide of iron	4·165
Lime	1·025
Magnesia	0·200
Potash	0·137
Soda	0·554
Sulphuric acid	0·160
Chlorine	0·065
Phosphates	0·025
	99·906 S.

The following observations upon the growth of indian corn were made by Mr. BALL, of Hoosic Corners, Rensselaer county, this last season (1848):

"Six varieties planted on a field descending to the north, on which a crop of eight-rowed yellow corn was raised the last year.

Composition of the soil before manuring.

Water	0·00
Organic matter	7·85
Silex	86·50
Alumina and peroxide of iron	5·50
Carbonate of lime	trace.
Magnesia	trace.
Loss	0·15
	100·00

Compost was applied, containing

20	parts of	barnyard manure;
10	"	hog manure;
10	"	wood ashes, leached;
1	"	lime;
1	"	plaster.

Composition of the soil after manuring.

Water	00·00
Organic matter	10·38
Silex	69·34
Alumina and peroxide of iron	10·50
Carbonate of lime	6·53
Magnesia	0·96
Sulphate of lime	1·74
Soluble silica	0·31
Chloride of sodium	0·06
Potash	0·09
Loss	0·09
	100·00

Wood ashes used in the hill.

Water		6·00
Charcoal		0·57
Silex		9·85
Carbonate of lime		66·75
Magnesia		3·40
Phosphates:		
of peroxide of iron	3·62	
Lime	3·25	
Magnesia	2·19	
		9·06
Potash		3·00
Chloride of sodium		0·44
Soluble silica		0·08
		99·15

One whole stalk of corn (eight-rowed brown), four weeks after planting.

Whole height 18 inches.

	PROPORTIONS.
Stalk	60·00
Leaf sheaths	60·50
Leaf	68·50
	189·00

Water in stalk	56·00		
Ash in do	0·10		
Organic matter	3·90		
		60·00	
Water in leaf sheath	55·50		
Ash in do	0·25		
Organic matter	4·75		
		60·50	
Water in leaf	57·25		
Ash in do	1·37		
Organic matter	9·88		
		68·50	
In the whole stalk:			
Water		168·75	
Ash		1·72	
Organic matter		18·53	
			189·00

One whole stalk of corn (eight-rowed brown), five weeks after planting.

Whole height 32 inches.

	PROPORTIONS.		
Stalk			307·50
Leaf sheaths			133·00
Leaves			181·00
			621·50
Water in stalk	287·40		
Ash in do	2·87		
Organic matter	17·23		
		307·50	
Water in leaf sheath	119·69		
Ash in do	2·00		
Organic matter	11·31		
		133·00	
Water in leaf	146·00		
Ash in do	4·03		
Organic matter	30·97		
		181·00	
Water in the whole		553·09	
Ash do		8·90	
Organic matter		59·51	
			621·50

One whole stalk of corn (eight-rowed brown), six weeks after planting.

Whole height 39 inches.

	PROPORTIONS.
Stalk	611·00
Leaf sheaths	279·25
Leaf	427·00
	1317·25

Water in stalk	568·25	
Ash in do	4·00	
Organic matter	38·75	
		611·00
Water in leaf sheaths	252·00	
Ash in do	2·75	
Organic matter	24·50	
		279·25
Water in leaf	358·94	
Ash in do	5·25	
Organic matter	62·81	
		427·00
Water in the whole		1179·19
Ash in do		12·00
Organic matter		126·06
		1317·25

One whole stalk of corn (eight-rowed brown), seven weeks after planting.

Whole height 53 inches.

	PROPORTIONS.
Stalk	1230·00
Leaf sheaths	289·50
Leaf	763·62
	2283·12

Water in stalk	1167·00	
Ash in do	8·50	
Organic matter	54·50	
		1230·00
Water in leaf sheaths	255·75	
Ash in do	4·50	
Organic matter	29·25	
		289·50
Carried forward		1519·50

Brought forward		1519·60
Water in leaf	630·37	
Ash in do	11·80	
Organic matter	121·75	
	763·92	
Water in the whole	2283·12	
Ash in do	24·80	
Organic matter	305·80	
		2613·72

One whole stalk of corn (eight-rowed brown), eight weeks after planting.

Whole height 68 inches.

Stalk	3009·00
Leaf sheaths	963·60
Leaf	903·75
Tassel	317·25
	5193·60

Water in stalk	2813·33	
Ash in do	17·96	
Organic matter	168·71	
	3000·00	
Water in leaf sheath	861·60	
Ash in do	9·60	
Organic matter	92·50	
	963·60	
Water in leaf	735·13	
Ash in do	19·87	
Organic matter	148·75	
	903·75	
Water in Tassel	230·94	
Ash in do	4·62	
Organic matter	81·69	
	317·25	
Water in the whole	4640·90	
Ash in do	51·95	
Organic matter	491·65	
		5184·60

One whole stalk of corn (eight-rowed brown), nine weeks after planting.

Whole height 78 inches.

	PROPORTIONS.
Stalk	4304·07
Leaf sheaths	1706·25
Leaf	1789·50
Tassel	483·50
Young ear	668·00
	8851·32

TABLE DESIGNED TO SHOW THE PROGRESSIVE GROWTH OF SEVERAL VARIETIES OF MAIZE RAISED IN THE TOWN OF HOOSIC, RENSSELAER COUNTY, IN 1848.

Number and name of variety.	Manure in hill.	Number of row.	Day of month corn planted.	Day of month corn begins to appear above ground.	Day of month when all the corn appears above ground.	Day of month each begins to tassel out.	Day of month each begins to flower.	Day of month corn cut up when ripe.	Average height 2 weeks after planting.	Average height 4 weeks after planting.	Average height 6 weeks after planting.	Average height 8 weeks after planting.	Average height 10 weeks after planting.	Whole weight of 32 stalks.	Weight of stalk.	Weight of leaf.	Weight of leaf sheath.	Weight of husks.	Weight of shelled corn.	Weight of cobs.
			May	May	May	July	July	Aug											lbs.	oz.
Gold Sioux. No. 1.	H. m.	1	15	19	23	15	21	17	5 in	15 in	42 in	72 in	84 in	18·7	4·1	1·5	1·1	1·0	8·0	3·0
	Ashes.	2	15	21	25	17	22		3 "	11 "	35 "	58 "	75 "							
8-rowed brown No. 2.	H. m.	3	15	21	22	4	14	16	5½ in	15 in	43 in	70 in	78 in	15·4	2·4	1·1	0·13	1·2	7·14	2·2
	Ashes.	4	15	22	23	7	16		4 "	12 "	36 "	64 "	76 "							
8-rowed yellow. No. 3.	H. m.	5	15	22	25	7	15	16	5½ in	12 in	42 in	64 in	90 in	19·13	4·4	1·7	1·2	1·4	9·6	2·6
	Ashes.	6	15	24	28	10	16		2½ "	10 "	36 "	60 "	82 "							
Sweet corn. No. 4.	H. m.	7	15	22	25	14	19	19	4½ in	11 in	34 in	60 in	78 in	18·8	3·6	1·1	0·8	1·0	6·1	1·8
	Ashes.	8	15	23	27	19	21		1½ "	8 "	33 "	57 "	72 "							
Chinese. No. 5.	H. m.	9	15	22	24	17	28	Sept 12	6 in	16 in	46 in	70 in	108 in	26·11	9.6	2·3	1·10	1·13	7·6	4·5
	Ashes.	10	15	23	26	22	30		2½ "	10 "	32 "	60 "	104 "							
Jersey White. No. 6.	H. m.	11	15	19	23	17	28	Sept 14	6 in	17 in	46 in	75 in	102 in	26·12	9·11	2·3	1·7	1·15	9·1	3·1
	Ashes.	12	15	21	28	23	31		2 "	13 "	32 "	67 "	96 "							

TABLE SHOWING THE CONNEXION OF THE GROWTH OF MAIZE WITH THE TEMPERATURE OF THE SOIL AND THE AIR.

No. of row.	1st and 2d week.	Mean temp.	3d and 4th week.	Mean temp.	5th and 6th week.	Mean temp.	7th and 8th week.	Mean temp.	9th and 10th week.	Mean temp.
1	5 in.	Air.	10 in.	Air.	27 in.	Air.	30 in.	Air.	12 in.	Air.
3	5$\frac{1}{2}$ "	76·30	9$\frac{1}{2}$ "	72·53	28 "	85·80	27 "	78·26	8 "	80·00
5	5$\frac{1}{2}$ "	Soil.	6$\frac{1}{2}$ "	Soil.	30 "	Soil.	22 "	Soil.	26 "	Soil.
7	4$\frac{1}{2}$ "	67·76	6$\frac{1}{2}$ "		23 "	80·53	26 "	76·13	18 "	74·93
9	6 "		10 "	65·73	30 "		24 "		38 "	
11	6 "		11 "		29 "		29 "		27 "	

NOTE. The mean temperature is that of the hour of 3 P. M.

"One half the corn was manured in the hill with hog manure, and one half with unleached ashes. The first was properly attended to; but in that manured with ashes, owing to the carelessness of the person who had it in charge, the whole sixteen hills were put together, and the varieties so mixed that I was obliged to let it go; and of course have confined what I have done to the portion manured with hog manure.

"During a part of the months of August and September, the observations on the weather were not quite so complete as I intended to have them: winds, clouds, and rain were not always noted."

It was my purpose to have given a more complete analyis of Mr. BALL'S varieties of corn. Circumstances, however, do not permit me to do this at this time. Observations on temperature, when connected with other meteorological facts, are highly important and interesting, especially when made for the purpose of illustrating their influence upon the growth and progress of vegetation. The section of country, too, where these observations are made, is remarkable for the growth of this crop. Hoosic, in Rensselaer county, is probably one of the best townships in this respect in the State; the crops being always large, and remarkably sound and perfect.

It is proper to say, also, that the analysis of the soil after manuring gave those results from the hills of corn to which the manure was directly applied. If such an amount of manure had been distributed generally through the soil of the field, its presence could hardly have been detected by analysis.

PROXIMATE ORGANIC ANALYSIS OF FIVE VARIETIES OF RIPE MAIZE.

PROPORTIONS.

1. *Golden Sioux corn*, 100·00 grs. gave

Water	15·02
Dry	84·98

2. *Large 8-rowed yellow corn*, 100 grs. gave

Water	14·00
Dry	86·00

3. *Small 8-rowed yellow corn*, 100 grs. gave

Water	14·03
Dry	85·97

4. *White-flint corn*, 100 grs. gave

Water	14·00
Dry	86·00

5. *Ohio dent corn*, 100 grs. gave

Water	14·50
Dry	85·50

1. *Proximate analysis of the Golden Sioux corn.*

A bright yellow 12-rowed variety, passing into 14 rows; frequently 14 rows at the base of the ear. It may perhaps be begarded as an improved variety of BUEL's *Dutton corn;* as it ripens earlier, and I believe has a smaller kernel.

Starch	36·06
Gluten	5·00
Oil	3·44
Albumen	4·42
Casein	1·92
Dextrine	1·30
Fibre	18·50
Sugar and extractive matter	7·25
Water	15·02
	100·05

2. *Organic analysis of the Ohio Dent corn.*

One of the largest varieties of maize.

Starch	41·85
Gluten	4·62
Oil	3·88
Albumen	2·64
Casein	1·32
Dextrine	5·40
Fibre	21·36
Sugar and extract	10·00
Water	10·00
	101·07

3. *Organic analysis of the small 8-rowed corn.*

Starch	30·290
Gluten	5·600
Oil	3·900
Albumen	6·000
Casein	2·200
Dextrine	4·615
Fibre	26·800
Sugar and extract	5·200
Water	13·400
	98·000

4. *Analysis of White-flint corn.*

Grown upon a clay loam, and manured in the hill with a mixture of coal, ashes and horsedung, and ashed with unleached ashes twice.

Starch	40·34
Gluten	7·69
Oil	4·68
Albumen	3·40
Casein	0·50
Dextrine	2·90
Sugar and extractive matter	8·30
Water	14·00
Fibre	18·01
	99·72

The water has been determined from the ground grain, and some oil has been found upon the paper enveloping its contents : probably the water may be stated too high by one pe

5. *Organic analysis of the larger variety of 8-rowed yellow corn.*

Starch	49·22
Gluten	5·40
Albumen	3·32
Oil	3·71
Casein	0·75
Fibre	11·96
Dextrine	1·89
Sugar and extract	9·55
Water	14·00
	99·80

The amount of starch in this variety was unexpected, and a small part may be set down as adherent albumen.

ADDITIONAL ANALYSES OF WHITE-FLINT CORN.

1. *Analysis of the kernels of White-flint corn, cut August 22.*

Grown upon the same soil as the small 8-rowed yellow, a sandy loam, and manured in part with coal ashes.

Silica	9·500
Alkaline and earthy phosphates	35·500
Lime	0·160
Magnesia	2·410
Potash	23·920
Soda	22·590
Chlorine	0·405
Sulphuric acid	4·385
Organic matter	0·367
	99·237

2. *Analysis of the leaves of the White-flint corn, cut August 22.*

Silica	53·550
Earthy phosphates	19·250
Lime	6·092
Magnesia	1·250
Potash	12·762
Soda	8·512
Chlorine	9·762
Sulphuric acid	4·185
	101·371

Tuscarora becomes a pure kind, and free from intermixture. The result is much like grafting or budding. The stock may influence the character of the fruit, but still it retains very much of its own individuality.

The question, however, which I wished to determine definitely in bringing up this subject, is, whether these kinds, growing thus together upon one cob or in one habitation, are really as different in the internal constitution as they are in their external appearance. Jackson maintains they are, and with good reason; but his opinion was not founded upon a real analysis. I have therefore attempted to settle the question in this way. I accordingly selected an ear bearing the Tuscarora, a large 8-rowed yellow, and the Sweet corn varieties, which are at the extremes in appearance, here meet upon one ground, and hence were subjects suitable for my inquiry. Another variety, however, seemed to have originated in the relations in which these stood to each other in the field — a variety between the Tuscarora and the 8-rowed yellow.

1. *Composition of the Sweet corn*, as determined by a proximate organic analysis.

Starch	11·60
Gluten	4·62
Oil	3·60
Sugar	6·62
Albumen	14·30
Casein	5·84
Dextrine	24·82
Fibre	11·24
Extract	8·00
Water	10·32
	100·96

2. *Analysis of the Tuscarora corn.*

Starch	48·90
Gluten, Oil	undetermined.
Albumen	8·72
Casein	2·32
Dextrine	2·00
Fibre	14·00
Sugar and extract	10·00
Water	13·68
	99·62

3. *Analysis of the Yellow corn*, grown upon the same ear as the two preceding.

Starch	50·83
Gluten	2·58
Oil	2·18
Albumen	1·00
Casein	3·42
Dextrine	3·12
Sugar and extract	9·13
Fibre	14·00
Water	undetermined.
	86·26

4. *Analysis of a beautiful variety of maize*, which, if it has no name, I would call ***Lady-finger corn.*** The ear is quite small, slender, delicate and white, but grows upon a remarkably long stalk at least seven feet high. It bears, at three or four joints, an ear, and sometimes two. It ranks among the small varieties, the *Pop corn*, and this is considered by far the best. It contains

Starch	46·90
Gluten and sugar	9·24
Oil	6·96
Albumen	5·02
Casein	2·50
Dextrine	2·25
Fibre	8·50
Extract	7·02
Water	12·12
	99·51

The Lady-finger corn is one of the finest varieties of pop corn, which has yet been cultivated for that special use.

5. *Analysis of the Calico corn.*

Starch	53·40
Gluten	3·22
Oil	2·80
Sugar	2·80
Albumen	8·96
Casein	1·00
Dextrine	2·41
Extract	9·60
Fibre	3·20
Water	12·55

This may be regarded as one of the most interesting among the varieties. Its kernel seems to be made up internally of meal or starch, and protected only by a thin cuticle. The chit or embryo is oily, and apparently the oil is confined to this part. It is the extreme variety on the side of starch, while the Sweet corn is the extreme on the side of dextrine and sugar.

6. *Analysis of the ash of the corn and cob of the large Ohio Dent corn.*

	PROPORTIONS.	
Weight of the ear	5993·00	grs.
Weight of kernels	2652·36	
Weight of cob	1114·40	

		Per centum.
2000·00 grs. of kernels gave ash	17·12	0·855
1014·40 grs. of cob gave ash	9·25	0·911

1. *Ash of the corn.*

Silica	1·80
Earthy phosphates	60·49
Alkaline phosphates	13·12
Lime	0·10
Magnesia	0·03
Potash	20·73
Soda	5·31
Chlorine	0·10
Sulphuric acid	0·71
Carbonic acid	none.
	102·39

2. *Ash of the cob.*

Silica	25·62
Earthy phosphates	8·79
Carbonate of lime	0·40
Magnesia	0·20
Potash	29·02
Soda	9·40
Chlorine	0·41
Sulphuric acid	12·00
Carbonic acid and organic matter	13·40
	99·15

It appears from the foregoing analyses, that we have the extreme limits in the amount of starch and dextrine in the Sweet, Tuscarora, and Calico varieties of maize : in the former, it is reduced to the lowest limit; in the Calico, it attains its maximum of starch. In the Sweet corn we find the maximum of dextrine, and in the other two only an ordinary amount, probably not an extreme.

In the presence of this large quantity of dextrine in Sweet corn we find the true reason of its shrinking so much, or of its assuming so much the appearance of a green or unripe grain. Dextrine, which, though it resembles very closely a gum, still differs essentially from true gum, of which Gum arabic is a type; but it swells when moistened, and shrinks again like gum when dried. A familiar example of shrinking and expanding is found in the gum which exudes from cherry or peach trees : in a wet day, it is four or five times as bulky as in a dry. So Sweet corn, when recently gathered, is full, plump, and with its skin distended: when it is dried, it shrinks, from the contraction of its gummy matter, the dextrine within the kernel. Probably too all the dent grains, or varieties of maize which exhibit a dent or depression upon the exterior, contain more dextrine than those which remain full and distended. The Ohio Dent, it will be observed, contains 5·40 per centum of dextrine, an amount exceeding that of the common yellow varieties of maize. It adds to the interest of the subject, to find the extremes of starch and dextrine growing or borne upon the same ear; thus proving the correctness of the opinion of Dr. Jackson, already referred to, with respect to the appropriation of nutriment by each individual kernel; for we find, upon analysis, that the difference of composition is as great as that of any two varieties cultivated at a distance and upon different soils. Indeed the facts are more striking in the case of these varieties, inasmuch as they obtain their nutriment from the same identical storehouse, or the same system of vessels. It all goes to prove, too, that each individual kernel modifies its food after its own manner; and it is this power which gives it its individuality.

MIDDLE-SIZED EIGHT-ROWED YELLOW CORN.

The following analyses exhibit the composition of the ash of the kernels and cobs of three specimens, grown on different soils, in Lewis county, in 1847. They were furnished by Mr. BEECH.

1. *Specimen grown on a clay loam.*

Cobs of medium firmness, and well covered with plump kernels.

1. *Ash of kernels.*

Carbonic acid	trace.
Silicic acid	1·450
Coal	1·650
Phosphate of iron	4·350
Phosphoric acid	57·365
Lime	0·150
Magnesia	10·110
Potash	8·286
Soda	10·908
Chloride of sodium	0·249
Sulphuric acid	0·206
Organic acids	3·100
	97·824 S.

PROPORTIONS.

Water	7·750
Dry matter	92·250
Ash	1·340
Percentage of ash calculated on dry matter	1·452 S.

2. *Ash of cob.*

Carbonic acid	11·500
Silicic acid	7·562
Sulphuric acid	not determined.
PHOSPHATES (24·125):	
Phosphate of iron	0·313
Lime	1·797
Magnesia	9·435
Silicic acid	0·313
Phosphoric acid	12·267
Lime	0·740
Magnesia	0·050
Potash	33·605
Soda	9·250
Chloride of sodium	5·512
Organic acids	5·450
	97·794 S.

PROPORTIONS.

Water	6·890
Dry matter	93·110
Ash	1·560
Ash calculated on the dry matter	1·675 S.

2. *Specimen grown on a sandy plain, which had a top dressing of manure.*

Cobs light and spongy, but well covered with kernels.

RELATION OF KERNELS AND COB.

		Per centum
Kernels	1790·6	83·935
Cob	329·5	16·065
Weight of one ear	2120·1	

1. *Ash of kernels.*

Carbonic acid	trace.
Silicic acid	2·500
Sulphuric acid	0·055
Phosphoric acid	54·160
Phosphate of peroxide of iron	1·550
Lime	0·191
Magnesia	11·040
Potash	13·031
Soda	16·885
Chloride of sodium	0·215
Organic acids	trace.
	99·627 S.

PROPORTIONS.

Water	7·69
Dry matter	92·31
Ash	1·58
Ash calculated on the dry matter	1·71 S.

2. *Ash of cob.*

Carbonic acid	13·000
Silicic acid	13·300
Sulphuric acid	0·413
Phosphates (15·55):	
Phosphate of iron	trace.
Lime	1·720
Magnesia	2·584
Phosphoric acid	11·246
Carried forward	42·263

Brought forward	42·263
Lime	0·497
Magnesia	0·368
Potash	35·993
Soda	11·894
Chloride of sodium	1·325
Organic acids	5·850
	98·190 S.

PROPORTIONS.

Water	7·140
Dry matter	92·860
Ash	1·360
Ash calculated on dry matter	1·464 S.

3. *Specimen grown on an intervale without manure.*

Cobs very firm, and well covered with plump kernels.

RELATION OF KERNELS TO COB.

		Per centum.
Kernels	1727·15	80·511
Cob	418·08	19·489
Weight of one ear	2145·23	100·000

1. *Ash of kernels.*

Carbonic acid	trace.
Silicic acid	2·650
Sulphuric acid	0·132
Phosphoric acid	56·050
Phosphate of iron	0·750
Lime	0·450
Magnesia	8·750
Potash	5·191
Soda	19·184
Chlorine	0·098
Organic acids	3·450
Coal	1·750
	98·455 S.

PROPORTIONS.

Water	7·630
Dry matter	92·370
Ash	1·615
Ash calculated on the dry matter	1·748 S.

2. *Ash of cob.*

Carbonic acid	9·405
Silicic acid	9·985
Sulphuric acid	1·306
Phosphates (21·163):	
Phosphoric acid	13·135
Phosphate of iron	0·415
Lime	1·643
Magnesia	5·555
Silicic acid	0·415
Lime	2·190
Magnesia	1·190
Potash	34·470
Soda	11·425
Chloride of sodium	1·960
Organic acids	6·450
	99·544 S.

Proportions.	
Water	6·880
Dry matter	93·120
Ash	1·325
Ash calculated on the dry matter	1·423 S.

PROXIMATE ORGANIC ANALYSES OF THREE VARIETIES.

1. *White Kentucky dent corn.*

		Calculated without the water.
Starch	50·92	58·710
Oil	0·64	0·737
Zein or gluten	0·72	0·830
Dextrine or gum	3·08	3·551
Fibre after boiling severally in alcohol and a weak solution of caustic potash	9·70	11·184
Matter dissolved out of fibre by a weak solution of caustic potash	2·62	3·020
Albumen	4·44	5·119
Casein	0·80	0·922
Sugar and extractive matter	13·80	15·911
Water	12·22	
	98·94 S.	99·984

In the above analysis, the oil and zein were obtained only from the fibre.

2. *Small blue corn*, used for parching.

After drying at 180°, it gave

Starch	42·56
Oil	5·30
Sugar and extractive matter	15·32
Dextrine or gum	7·52
Fibre after digesting severally in alcohol and a weak solution of caustic potash	8·56
Matter taken up from fibre by a weak solution of caustic potash	8·54
Albumen	5·00
Casein	2·04
Zein or gluten	4·78
	99·64 S.

3. *Early 8-rowed White-flint*, raised by Mr. BEMENT of Albany.

		Calculated without the water.
Starch	57·47	67·573
Oil	2·55	2·909
Fibre	6·07	6·925
Dextrine or gum	4·01	4·575
Sugar and extractive matter	13·21	15·072
Albumen	2·27	2·590
Casein	0·39	0·444
Zein or gluten	1·67	1·905
Water	11·46	
	99·10 S.	99·793

On the changes which have taken place in the relative proportions of the inorganic matter at different periods of growth. That certain changes take place in the relative amounts of the inorganic matter, appears highly probable from the phenomena of vegetation in general. If, however, we collect the facts as established by the foregoing proportions (see pp. 160 – 192 inclusive), it seems established that certain elements vary in their respective amounts, when the young is compared with the old or mature plant. As silica, or silicic acid, is one of the elements essential to the composition of the plant, it will be found to have changed its relative proportions. In the leaves, for example, it increases very regularly from the earliest stage till its maturity is acquired. In the sheaths, the same fact is established: thus, in July, the percentage of silica was 11·60; in October, 51·25. In the stalks, it was 2·50 in August; in October, 12·85. The phosphates also change places; but instead of there being an increase in the leaves as they increase in age, it diminishes. Thus the phosphates of the sheaths, in July, amount to 10·40 per centum; they decrease till about the 2d of August, when they amount to 8·9; they increase again to 12·70 per

centum, when they decrease to 9·75 per centum. In the stalks, however, analogous changes occur, an increase followed by a decrease. The alkalies of the sheaths, especially soda, diminish from 34·48 to 22·44 per centum. The alkalies of the stalks diminish from 35 in the case of soda, to 17·79; and in potash, from 13·35 to 11·11.

As the most important elements of the fruit or grain are alkalies and phosphates, they seem to be first elaborated in the leafy parts, or perhaps in connexion with the organic matter, the fluids, vitalized and fitted to fulfil the most important offices in the most important parts. A direct transference from the soil to the seed would seem to put them in this important part unprepared, and hence they pass into the foliage, and there undergo those changes which especially fit them for the office of continuing the species. Hence, too, in the ripening of seed, the source of nutriment is the foliage, and hence too the most important matters may appear to have diminished in amount. The silica, however, being required in seed for the purpose of protecting it, is rarely if ever in such abundance as to diminish the amount of it in leaves and stalks. Hence the proportion is relatively greater in the ripe than in the unripe stem; and so too as silica is the element of support and strength, it is the more necessary to the foliage when exposed to winds and rains until it attains its full size and growth : it is required here; but in the fruit, silica would be a damage, except as a thin covering to protect the soft and delicate embryo.

The foregoing facts are a clue to the true and proper time for cutting corn as a fodder; inasmuch as it is evident it ought to be done before the phosphates and alkalies pass to the seed and fruit, and before the silica predominates so far as to reach its maximum quantity. Just before and at the period of blossoming, analysis shows that they should be cut. Then too the stalks and leaves are less woody : there is less fibre and more nutritious matter in the same weight. The leaf particularly becomes woody and siliceous. The stalk, when of moderate size, is more valuable than the leaf.

ON THE COMPARATIVE VALUE OF CORN FOLIAGE FOR FODDER.

Having stated at considerable length the proportions of the parts composing the maize plant, and also the composition of its organic and inorganic matters, I propose now to consider some of those properties which indicate its relative value as a cereal, and its importance as one of the nutriments designed for man and animals.

On this last point, I may remark here that the importance of this grain is indicated in the great extent of territory over which it is susceptible of cultivation. To the north, it is not forced from the soil by cold until we reach a latitude of near 50 degrees. So its cultivation is feasible as far south of the equator; and under the equator, it is grown at an elevation of 7500 feet. In the latitude of Albany, it nearly reaches its vertical limit of cultivation at the height of 12 or 1500 feet. The extent of its cultivation is of course

greatly increased in consequence of its annual growth, and its requiring only a season to perfect its grain.

Another fact equally strong in itself, is its disposition to form varieties, which adapt themselves to the climate or the length of the season. In this constitutional power, it exceeds I believe all the other cereals. It has been observed that from 75 to 100 varieties are known. Some of these varieties attain maturity with great rapidity; others more slowly, in which case they usually attain a great height, sometimes that of small trees. The growth of the latter is as rapid as the former, but their size is not completed till after the lapse of ninety days.

Of the comparative value of maize. In estimating the value of an article of food, it is essential that we take into account the amount produced on a given surface, and the extent to which it exhausts the soil. I will attempt to ascertain these amounts in this place, inasmuch as they are both important and valuable elements with which the farmer should become familiar.

Amount obtained in an ordinary crop of maize. As all parts of the plant are more or less valuable, and inasmuch too as they take from the soil valuable elements, it will be instructive to state how much is thus removed in the crop, in the leaves, stalks, silks, tassels, husks, cobs and grains. An acre of land may be estimated as producing 4900 hills, with three perfect plants, or stalks as they are usually called. They may be supposed to stand in rows three feet apart, and to range in true lines in two directions. Taking the White-flint corn for our estimate, it will be found by reference to page 167, that a plant of this variety gives the following weights of its several parts:

	Green.	Dry.	Ash.
Tassels - - - - -	130·7 grs.	57· grs.	4·37 grs.
Stalks - - - - -	5766·9	880·1	35·75
Leaves - - - - -	2797·	763·8	81·35
Sheaths - - - - -	2536·	494·	40·46
Husks - - - - -	3534·	802·	29·53
Silks - - - - -	57·	36·	1·72
Cobs - - - - -	2935·5	864·	18·
Kernels - - - - -	4170·5	1633·	32·7
	22007·6	4022·9	243·88

In a single plant there are 4023 grains of dry matter, in which there is dissolved 243·88 grains of inorganic matter, consisting, as will be observed in the analyses, of phosphates, soluble silica, potash, soda, etc. A field of an acre contains, as has been indicated, 14700 of such plants, weighing probably some more and some less, but whose average amounts will not differ materially from the weight of the plants already determined and referred to. So it is probable that more than three plants will be found in a hill; but assuming this as the number, it will be easy for any one to compute the variations which may arise from a greater or less number of plants in the field.

The number of plants in an acre amounts to 14700; and they will remove from the soil 3585036 grains, or 7468·82 oz. = 466·80 lbs. of inorganic matter. Of the 3585036 grains, the parts of the plant will contain, in the

Tassels	64239 grs.
Stalks	525525
Sheaths	594962
Leaves	1195845
Silks	25284
Husks	434091
Cobs	264600
Kernels	480690
	3585236

From the foregoing results, we find that the amount of elements removed in the entire crop of one acre will stand as follows:

The tassels and stalks will contain

	Tassels.	Stalks.
Silica	5·105 lbs.	8·789 lbs.
Earthy phosphates	0·822	10·362
Lime	0·196	1·928
Magnesia	0·053	0·640
Potash	0·573	11·087
Soda	0·744	17·094
Chlorine	0·198	7·491
Sulphuric acid	0·332	7·382
	8·023	64·773

The leaves and sheaths,

	Leaves.	Sheaths.
Silica	82·681 lbs.	39·667 lbs.
Earthy phosphates	29·272	7·546
Lime	9·406	1·581
Magnesia	1·910	0·589
Potash	19·704	5·571
Soda	13·142	9·262
Chlorine	15·072	2·202
Sulphuric acid	6·461	8·928
	177·648	75·356

The husks,

	Husks.
Silica	26·922 lbs.
Earthy phosphates	14·831
Lime	0·254
Magnesia	0·040
Potash	1·984
Soda	5·555
Chlorine	3·141
Sulphuric acid	3·770
	56·497

The cobs and kernels,

	Cobs.	Kernels.
Silica	4·678 lbs.	5·939 lbs.
Earthy phosphates	8·229	22·187
Lime	0·103	0·100
Magnesia	0·309	1·506
Potash	12·315	14·950
Soda	2·034	14·118
Chlorine	0·045	0·309
Sulphuric acid	0·118	2·740
	27·831	61·849

The several amounts, according to the foregoing results, will stand as follows:

	lbs.	oz.
Silica	173	12·496
Earthy phosphates	93	3·984
Lime	13	9·248
Magnesia	5	0·752
Potash	66	2·944
Soda	61	15·184
Chlorine	28	7·328
Sulphuric acid	29	11·696
	471	15·632

Maize must be ranked then among the most exhausting crops. It is evident that poor soils will scarcely repay the farmer for its cultivation. It is evident, too, that unlike other cereals, there is little danger of using too much manure in its cultivation. It is not liable to run to foliage, and thereby fail to produce grain; neither will it lodge, or fall down by its own excessive disproportion of organic to its inorganic matter.

There is one more important view which may be taken of the analyses: they will dispel the notion so frequently inculcated by writers and lecturers, that bone earth is the main

manure for a maize crop; or, rather, that it is enough to furnish a manure which consists of elements found in the grain or fruit. For the perfection of any crop, it is as necessary that the leaves, silks and tassels be furnished with their appropriate food, as the grain itself; for it can not be doubted but that the grain itself depends upon the full development of the parts which precede it. Supply them with matter suitable for their increase and perfection, and the grain is supplied also. It must not be forgotten that these parts very frequently contain elements which are not found, except in very small proportions, in the seed or grain; yet it is plain enough, that in some way or other, these elements are quite essential to their perfection.

The value of the maize crop does not depend solely upon its grain. The foliage, including the stalk, is freely eaten by cattle and horses; and, if properly dried, it is by no means an inferior kind of fodder. The amount of green foliage raised on an acre furnishes two or three tons of dry fodder. By reference to the analyses of the foliage, pp. 225–6–7, the leaves, stalks, sheaths, tassels, etc. contain albumen, casein, dextrine, oil, wax and sugar; substances necessary to the sustenance of the animal body, and which are required to supply the waste of the system. These are both nitrogenous and heat-producing bodies, or contribute to the growth of muscle, the generation of heat, and the formation of fat; and it will be seen that the amount of these elements is very considerable, from the great amount of foliage produced.

For a more satisfactory solution of the problem respecting the value of the maize plant as a nutriment, it may be compared with several species of grasses. Nutriment for domestic animals consists of bodies which have been described in the first part of this report; they are mainly albuminous. Casein is found in milk, and exists in most vegetables in a modified form. Starch, dextrine, resin, oil and wax exist in all vegetables which are eaten by cattle. The leaves and leafy parts furnish a mere trace of starch. Upon their surface there exists a green coloring matter called *chlorophyl*, which is insoluble in water, and which is always associated with wax. The wax protects the surface from the action of rain and dew; and when the plant is cut for food, it supplies in the system the place of oil, and aids in maintaining the temperature of the body. The chlorophyl and wax cover the surfaces of fruits, and serve the same purposes as in the leaf, and impart that glossy character to the outside which is always admired in red and high colored fruits. Wax and chlorophyl, as may be observed in the foregoing analyses, have always been obtained from the stalks and foliage of corn (see pp. 224 and onward).

The analyses of the young maize plant, very dry, cut July 5, gave the following results:

Fibre or insoluble matter - - - -	59·00
Sediment from the solution in water - -	3·72
Albumen and casein - - - - -	7·96
Dextrine, sugar and extract - - - -	26·40
Water - - - - - - - -	3·67
	100·25

The wax was not obtained: it is a product, however, which varies less than most other

The same kind of corn, cut July 16, gave

Fibre or insoluble matter - - - - -	49·44
Sediment, mostly fibre - - - - - -	8·82
Extract containing sugar - - - - - -	18·00
Albumen, with adhering chlorophyl and some fibre,	4·00
Resin - - - - - - - - - -	1·30
Chlorophyl and wax, mostly wax - - -	2·82
Water - - - - - - - - - -	8·76
Casein - - - - - - - - - -	1·70
	94·86

The foliage of the ripe plant, cut September first, gave

Fibre - - - - - - - - - -	61·24
Fibre in the form of sediment - - - -	5·76
Extract and sugar, mostly extract - - -	19·00
Albumen - - - - - - - - -	0·23
Casein - - - - - - - - - -	1·60
Water - - - - - - - - - -	10·17
	97·90

The watery extract, when dry, has the flavor and taste of dry bread or rusk. This is the fact with all the sediments obtained by water from hay or the dried grasses. This flavor, with the slightly bitter principle of the extract, renders hay an agreeable and pleasant food to the ruminants. The amount of matter dissolved in cold water aided by macerating several days, and after pressing the insoluble fibre in a linen bag, furnishes from the maize foliage 40 to 60 per centum. All the soluble parts are taken up; and the fibre is left, after being dried, in the state in which it passes from the intestinal canal. This matter, which has been removed by water, is not entirely soluble: it appears, after standing, that the chlorophyl and wax are suspended in the menstruum, and by rest are slowly deposited. So some of the resinous matter is obtained in the watery solution. The solution, when its temperature is raised to 140 – 180°, gives invariably flakes of a coagulum which is undoubtedly albumen. So a precipitate is given afterwards by acetic acid.

These several products are more or less colored by, and still furnish the characteristics of, the elements to which they are referred. The chlorophyl does not appear to be assimilated, inasmuch as it appears in the excrements, and gives them in ruminants their green color. The wax, however, with which it is associated, disappears in part at least, and is undoubtedly, along with the resinous matters, comprised among the calorifient bodies.

The albuminous matters (including casein) which are destined to supply the waste in the animal system, in the maize plant cut July 5, amount to 7·96; in that cut in July 6, to 3·80; and in the leaves of the ripe maize cut September 1, to 1·83 per centum. In

July, therefore, there is more nutritive matter than in the earlier or later stage of the plant. This was to be expected. In the ripe plant, the leaf as well as the stalk becomes more insoluble.

If the nutriment of the foliage of maize is compared with that of the common grasses, it will be found that the latter are generally more nutritive than the former : thus, timothy hay furnished, in the dried state,

Fibre	68·14
Wax and chlorophyl	2·80
Albumen	1·89
Casein	2·34
Sugar, extract and dextrine	8·20
Water	12·30
	95·67

The albuminous matters amount to 4·23, and the calorifient to 11·00. I suppose that the extractive matter belongs to the calorifient bodies. Dextrine seems to replace starch in the grasses. When there is a pith, as in the maize stalk, we find a trace of starch.

Red-top, another common and favorite hay, gave the following results :

Fibre	65·00
Albumen	1·49
Casein	1·80
Chlorophyl and wax	11·62
Resin	3·08
Extract and sugar	9·00
Water	10·00
	101·99

The sediment, which is allowed to subside for twelve hours, is filtered from the solution before it is treated for albumen; and it is believed that considerable albumen goes down with this sediment, inasmuch as it is adhesive, and bears the characters of an albuminous body, although it is mixed very largely with fibre, chlorophyl and wax; but it is all reckoned with the fibre, and the albumen is only obtained by heat, and the casein by acetic acid. In the red-top, 3·29 is set down as albuminous; but 11·62 per centum of wax is rather a remarkable result : the wax forms the greatest part of this amount. The calorifient products are larger than in timothy, amounting to 23·70. It is probable the albuminous matters are stated too low, and that the deficiency arises from the subsidence of from one to two per centum with the sediment referred to above. If not, they exist in about the same proportion as in the corn of the middle of July.

The red clover contains less albuminous matter than the grasses, as will be seen from the following analysis:

Fibre	64·19
Albumen	1·57
Casein	trace.
Wax and chlorophyl	1·20
Resin	2·60
Extract and sugar	18·80
Water	9·60
	99·96

In the clover, the calorifient and fatty matters are in greater proportions than in the grasses or maize, while the matters required by muscle and sinew exist only in a small amount.

The white daisy (*Chrysanthemum leucanthemum*), so common in many meadows, and often thoroughly hated by the farmer, gave, in a partial analysis, the following results:

Chlorophyl and wax	3·60
Resin	1·44
Extract and sugar	8·96

The albuminous matters were not obtained. The calorifient properties equal the grasses; and I believe cows, when they become fond of it, give a rich milk. One hundred grains gave dry matter 22·09, ash 1·65.

A carex (one of the swamp grasses), but which was collected before it blossomed, gave results as follows:

Fibre	86·20
Chlorophyl and wax	2·00
Albumen	2·84
Casein	trace.
Resin	0·47
Extract and sugar	6·60
	98·11

The carex is therefore not deficient in albuminous matter. The waxy matter and sugar exist in a small amount only, while by far the greater part of the grass is fibre.

The *Glyceria fluitans*, which is an aquatic grass, the seeds of which are sweet and nourishing, is not much more valuable in its dry state than the carex. It consists of

Fibre	79·96
Albumen	2·40
Casein	trace.
Extract and sugar	7·00
Water	10·00
Chlorophyl and wax	1·20
	100·56

This grass is freely eaten by cattle, and it is sweet when green. Its watery extract, however, is not more sensibly sweet than that of the red-top.

The foregoing analyses of the grasses were made for the purpose of comparing their proximate composition with that of the maize plant. There is quite a striking similarity between them in the amount of wax and chlorophyl, while they differ in the quantity of woody fibre. This increases, however, with the age of the plant; but the samples employed were not too far advanced for the purposes in view.

The amount of water in the thoroughly sun-dried grasses is usually about 10 or 12 per centum, which seems to be about the quantity required constitutionally. The solutions were all obtained by cold water: the chlorophyl and wax were obtained by boiling in alcohol, the product of which was redissolved by ether, to separate the wax and chlorophyl. The remainder was steeped in water, which dissolved out the sugar and some extract, leaving a small quantity of resin, soluble only in alcohol.

The nutrient powers of the grain or kernel of maize varies considerably with the variety, as may be seen in the foregoing analyses. Starch, as a general rule, is the element in the greatest abundance; but it has been shown, that in one variety it is small, amounting to 11·60 per centum only. In this variety, the albuminous matters, including casein, are increased to 20·14 per centum. The gluten, which is a nitrogenous body, also, when counted with the albumen, gives us the additional quantity of 4·62 per centum of matter fitted to supply the waste of the system; or, in other words, to create nerve and muscle. It is the most nutritive of the varieties of maize. If the dextrine is added to the starch, this variety cannot be regarded as deficient in calorifient matter, and hence it is fully equal in calorifient powers to beans. In another point of view, it must be regarded as superior to beans, viz. its fattening properties; inasmuch as it contains 5·11 per centum of oil and sugar. Other varieties contain more than 50 per centum of starch, and less albuminous matters than the sweet variety. A reference to the analysis will probably furnish the reader with all the information he may wish.

It is probable that modes of cultivation will materially affect the composition of this grain. A high cultivation will increase the relative amount of certain elements: in one kind of management, the albumen may be formed in greater quantity; in others, the starchy. This idea, however, requires proof by experiment; and however it may prove, it is evident that maize is very remarkable in its varied composition, as it exists in its numerous varieties.

To what extent the nutrient powers of meal and flour are changed by cooking, has never been actually determined: their solutions are more or less altered. Thus the gluten of flour, which is soluble in alcohol, ceases to be so in bread: starch is probably changed into dextrine. The following is an imperfect analysis of bread, but may be stated for some of the facts which it contains:

Soluble in alcohol	7·40
Glutinous matter	5·00
Matter insoluble in cold water, and mixed with a little starch	21·32
Albumen	1·00
Casein	1·28
Dextrine	8·21
Sugar and extract	13·50
Water	40·00
	98·61

Fresh bread still contains 40 per centum of water.

DESCRIPTION OF SEVERAL VARIETIES OF MAIZE.

I have already alluded to the fact that maize, in the course of the period of its cultivation, has run into a great number of varieties. These are not only well characterized by their form and markings, but they seem to be as permanent as the species. The Sweet corn is a variety whose origin goes so far back that its history is lost. It was found in possession of the Indians of this country, and has not as yet materially changed in its features. The Tuscarora is also an old variety. The following descriptions of a few of the most common varieties cultivated in New-York, may be acceptable to those who have an interest in the production of kinds.

1. *Rocky-mountain corn* (Pl. 26, fig. 2 & 3). The principal feature of this kind is its tunic, or husk investing its kernel. This is long and pointed, and completely envelopes the kernel. From this interesting fact, this kind has been regarded by a few naturalists as a distinct species of maize. At first, the existence of such an envelope may appear to favor this view; but when it is known that all kernels of maize are originally furnished with a tunic in their young state, and also that this tunic disappears under cultivation, it seems to cast considerable doubt over the correctness of this opinion. In its present state, this is not a valuable variety, but is much like a wild plant that requires an exfoliation of its coarser coverings. This actually takes place, and the nutriment which formerly supported the husk is diverted to the grain. It improves, therefore, by cultivation, and probably may originate some valuable varieties. The size of the ear differs only a trifle from that of the Tuscarora, but it is loose and spongy. It is cultivated at present only as a curiosity.

2. *Tuscarora corn* (Pl. 26, fig. 1 & 6). Kernel large, white and flat, starchy; chit reddish, the corneous portion thin. Form trapezoidal, wide, with grooves on the upper side; the central one is a deep excavation extending from the chit to the outside or corneous part; lateral one narrow, and half the length of the central one. Inferior side convex.

The kernel is inserted upon a thick shortish reddish cob. Ear 8-rowed. It gives a white, nutritious flour. Specific gravity 1·110. Specimen furnished by Mr. N. Salisbury, Cortland county.

3. *Calico corn.* Color remarkably variegated with bright hues and intermixed with white. Cuticle thin, investing apparently a mass of starch, with a slightly reddish tinge. Ear eight-rowed. Cob chaffy. Specific gravity 1·066. Furnished by Mr. Jewett, of Addison county, Vermont.

This is beautiful on the ear: it is cultivated mostly as a curiosity, or for popping. The kernel contains a large amount of starch, and is deficient in gluten. It is the lightest of all the varieties.

4. *White-flint corn* (fig. 5). Color white. Corneous portion well developed, and investing the starchy portion. Ear long and slender, eight-rowed passing into twelve. Specific gravity of that raised last year, 1·266; of the specimen raised this year, 1·301. This is among the heaviest.

This variety (the small White-flint) is early, and hence must be regarded as one of the best kinds of maize. It is rich in oil, and gluten and starch, and hence for food it must rank very high; and as its meal is whiter than that of the yellow corn, it may be preferred for bread, especially when it is intended to mix it with wheat flour.

5. *Middle-sized eight-rowed yellow corn* (fig. 11). Yellow. Kernel large, oblong, flattish. Corneous portion well developed, investing a thick layer of starch. Groove single, wide. Ear cylindrical. Cob comparatively small, from nine to ten inches long; rows 8, and arranged at the base in twos. Specific gravity 1·316, and ranks with the 8-rowed white-flint in value, and seems to possess a higher specific gravity.

6. *Golden Sioux corn* (fig. 12.) Yellow. Ear large. Kernel thick and pointed; width subequal, sometimes higher than wide. Corneous portion well developed. Rows 12, and arranged in twos, or may be irregular; the number increasing to 14, and even 16 at the base, when they become crowded and irregular. Specific gravity, 1·299. The cob is large at the base, and hence is liable to mouldiness. It ripens late; and from these two defects, it is not so much esteemed as the smaller and earlier kinds. Its foliage is much greater, and the exhausting powers increased. The meal is as rich as that of either of the preceding kinds, provided it has ripened well. It is the Dutton corn of the late Judge Buel, as I am informed by Mr. Howard. It was introduced from the Indian country, first into the eastern part of Massachusetts, and afterwards into Vermont. One ear only is usually perfected on a single stalk.

7. *Small eight-rowed yellow corn* (fig. 15). Yellow, 8-rowed. It resembles the large 8-rowed, only it is smaller: it passes into that variety by cultivation, and can hardly be distinguished from it. That which was cut August 11, had a specific gravity of 1·241. Probably, when thoroughly dried, its weight is proportionally increased. It is a fine variety: being early, its foliage is smaller than that of the white-flint, and it frequently produces three ears upon a stalk.

8. *Twelve-rowed Canada corn.* Yellow, and frequently brownish. Cob

well developed. Kernels very hard, and set close upon the axis or cob; pointed, higher than wide. Rows irregular at their base. Corneous portion thick; groove single and wide. Specific gravity, 1·289. The cob of this variety is small, and the kind is early. It is esteemed by the Vermont farmers.

9. *Canada pop-corn*, *Egyptian corn* (fig. 4). Yellow. Color blue and dark purplish-red. Ear small, firm and hard. Cob small and reddish. There are several varieties of the yellow and the dark colored, all of them early and small, and used only for popping. Specific gravity of the dark-purplish Indian Canada pop-corn, 1·298.

10. *Rice corn*. White and yellow. Kernel pointed, mucronate, or the back terminates in a point where the silk was inserted. Rows 12 – 16, and irregular at base. Ear 4 to 6 inches long, and tapering. It is a beautiful variety, and probably one of the richest and sweetest. It bears from three to four ears on a stalk, but is rather unproductive. It is used principally for popping.

11. *Illinois* or *Lady-finger corn*. Pale yellow. Ear small, slender and tapering. Rows 12. Kernels small, pointed, rounded upon the back. It is an unproductive kind, bearing sometimes four ears upon a stalk, but the stalk is from 7 to 8 feet high. It is a late kind, remarkable for the great amount of stalk and leaves, or what might be termed offal.

The indented kinds are also quite numerous.

12. *Large Ohio Dent corn* (fig. 14). Ear large, cylindrical. Yellowish-white. Corneous portion placed upon the side; back indented. Starch extends to the investing membrane. Size remarkably large, and ears from 12 to 14 inches long. It has 868 kernels upon an ear, in 12 to 14 rows. Cob reddish and chaffy. One hundred and seventy bushels of this corn have been raised upon an acre.

13. *Virginia Golden corn* (fig. 9). Reddish-yellow, polished.

14. *Kentucky corn* (fig. 8). Kernel white, somewhat shrivelled, elongated and pointed.

Both these varieties are starchy and light, and are known in market as Ohio or Southern corn.

The large white-flint is a later variety of white corn, but is cultivated here occasionally. Its ear and kernel is large and white, with a specific gravity of 1·151.

DISEASES OF MAIZE.

The Maize Brand (*Uredo maydis*, Decandolle; *U. zeæ*, Chevalier).

Plate LVII. Fig. 1, 2.

All the species of brand, more or less, cause decisive injury to the organs of the plants which they infest; but the maize brand, among all the kinds of brand found in our cultivated grasses, produces the greatest and most extensive local transformations. It attacks

all the parenchymatous organs of the maize plant, and more or less completely destroys them. The stalk, however, and the female and male blossoms, are the parts which it most especially affects. The leaves no longer furnish the great parenchymatous masses necessary for their development; and usually it seizes merely on their lowest parts, or also only on the husk-bearer; but its development here is already imperfect, and it forms on the leaf-organs only brand-bladders of the size of a poppy seed to a pea. In all the parenchymatous organs, however, it developes itself in the form of masses; and in good soil, and in actual cultivation of the maize, I have seen brand-bladders of the size of a child's head. Its development is a peculiar one, as it forces out great masses of cellular tissue, formed from the tissue of the mother plant, and similar in formation to the latter.

Some parts of the organs affected by the brand, swell and become white. The green color and compact formation of the outer skin gradually passes into a soft watery tissue of a silky lustre, the skin of which allows the large cellular formation to be seen through it by the naked eye. If we more closely examine this pathological product, we find that it consists of tolerably large tender-walled substance, the cells of which, like that of the normal vegetable tissue, contain sap, and possess a large slimy cellular kernel sticking on the side. In each of these cells, at a later period, is secreted a slimy granulous substance, which is yellowish, and afterwards brownish, in which still later the brand is developed. Prof. MEYEN examined this brand formation very critically, and we may here be allowed to repeat his investigations:

At first is seen in the large and juicy cells of the maize plant, or especially in the pathological cellular substance, the above mentioned little deposites of slime, which are produced on the inner surface of the cellular walls. From these, at first wholly irregularly formed, almost transparent deposites, proceed fibrous, dismembered and branching structures, which already exhibit a plant-like form, and which by their later changes more clearly evidence the same. These truly parasitic formations are in the beginning colorless, almost entirely transparent, and only under a strong magnifying power exhibit a fine-grained organised structure in their tender slimy substance; but soon it is observed that particular boughs of this little plant are branched out; and in individual cases, yet more developed, branches and twigs stand closely crowded together. At the same time with this branching, the fibres are already partially separated into small globular bodies, sometimes at the base, and sometimes at the point of the fibres; but for the most part their little side branches first separate off themselves. Many fibres are wholly changed into little branches in a wreathed form, which still hang together. They are originally ellipsoidal, and then become more or less globular; are at first of a yellowish and afterwards of a brownish color, and at last brown. But they likewise separate themselves from the branches producing them, and often before they have reached their normal size, which follows after their separation as it were by a sort of after ripening. By and by all the fibres fall away into such spores or grains of brand; by and by, too, the cells of the diseased vegetable substance are destroyed; and if we carefully cut through lengthwise (Fig. 1, *b*) the brand-bladders not yet opened or sprung apart (Fig. 1, *a*), we find that the white

cellular substance appears to be interwoven with irregular masses of brand, partially isolated and in the form of cells : the cellular substance, which still remains standing, forms white sheath-walls and cells, or, better described, deficiencies, the hollow space of which is filled with the dark brown brand. By and by this remains of the cellular tissue, constituting sheath-walls, becomes absorbed, and only the outer skin of the brand-bladder continues standing; but it begins likewise to be colored reddish or smutty, to become wrinkled or in folds, to dry up, and finally to tear open, by which the substance of the brand-spores is emptied and as it were sown out.

This species of brand causes manifold degenerations of particular parts and organs of the mother plants. On the stalk it forms irregularly rounded brand-bladders, very greatly differing in size. On the female blossoms, it never attacks all the blossoms (*blüthen*) of an ear; the blossoms on the top of the ear are for the most part more exposed to the brand than those at the base. Often only those fruit-buds that stand at the very tip, and frequently only the basilar ones, are diseased. Here the brand attacks only the fruit-knot, and changes it directly into a brand-bladder; so that indeed a person may find on the latter still the remains of the wasted pistil. But the rachis (midrib?) itself I have never found entirely gone. More frequently it seizes on the husk-leaves, and then changes the whole ear, or the fruit-bearing branch, into an organ not unlike a pine apple : it thickens all the leaves, and forms them similar to the scales of a fir cone. But in the male blossoms (*blüthen*) the brand seizes on the receptacle and the anthers, more rarely the petals, and changes all these organs into white, curled-up, easily-bent brand-bladders, one to three lines thick and often two or three inches long, which are likewise white, and of a beautiful silky lustre, sligtly tinged with red at the tip and on the side springing open to let out the spores.

The spores (Fig. 2) in their normal state are globular, but they are very frequently likewise somewhat ellipsoidal : in a ripe state, they are brown. The spore-skin is covered with little warts; and on many spores may be observed a dark point in the middle, the little opening (feusterchen? hilum) by which they were fastened to the fibrous bearer. Their diameter varies from 0·000320 to 0·000340 Paris inch.

This species always impairs some blossoms, as soon as it is seated in the ear, while the other blossoms standing near bear good ripe kernels. The brand-bladders can be very easily removed from the living plants by cutting them out; only this must be done as timely as possible, in order that in cutting them out, the bladders may not scatter their powder, and thus a future crop of brand not be prevented. For seed only, kernels should be selected from plants which have remained wholly free from the brand. This kind of brand is, by the structure of its spores, different from all others, and only related to the wheat brand.

Explanation of the Illustrations.

Fig. 1, brand-bladders : *a*, on the stalk of maize of the natural size; *b*, such a brand-bladder cut through lengthwise. Fig. 2, spores strongly magnified.

NOTE. The smut of the maize may often become a serious injury to a crop. It forms its black smutty vesicles upon all parts, except perhaps the leaves. The ears, however, suffer the most, inasmuch as this is the valuable part of the plant. Probably the period when the ear is forming is the most favorable for the propagation and growth of this fungus. There can be but little doubt but that the spores of the fungus are taken up by the roots, and conveyed in the sap to all parts of the plant. Hence it should be a point to remove the smutted parts the moment they are discovered, and to burn them. In a small field of maize, where last year (1847) there were only a few infected stalks, they were multiplied this year more than ten times, and I believe solely from the neglect to destroy the fungus.

VII. BROOM CORN.

Broom corn, being closely allied at least to the cereals, may be placed with propriety in this connection. Observations, as in the case of maize, have been made upon its growth during the entire season. I did not deem it necessary, however, to follow them up with numerous analyses, although it is extensively cultivated in this State. The proportions which have been determined, answer the double purpose of showing the progress of the increase of the plant, and the amount of mineral matter which it contains at different stages and periods of growth. We can determine, from the same data, the exhausting powers of the crop.

PROPORTIONS.

TIME.	PARTS.	QUANTITY.	PER CENTUM.
1848.			
JUNE 27.	Whole plant - - - - - - -	100·00 grs.	
	Dry - - - - - - - -	14·04	14·09
	Ash - - - - - - - -	1·44	1·44
	Calculated dry - - - - -		10·25
JULY 5.	Height 16 inches. First joint just apppearing.		
	Leaf-blades - - - - - - -	52·24 grs.	60·886
	Leaf-sheaths - - - - - - -	33·56	39·114
	Weight of whole plant - - - -	85·80	100·000
	1. *Leaf-sheaths* - - - - - -	33·56	
	gave of Water - - - - - -	30·52	90·912
	Dry matter - - - - - -	3·04	9·088
	Ash [decided taste of potash] - -	0·48	1·427
	Percentage of ash calculated dry - -		15·702
	Percentage of organic matter - - -		84·298

TIME.	PARTS.	QUANTITY.	PER CENTUM.
JULY 5.	2. *Leaf-blades*	52·24 grs.	
	Water	45·78	83·805
	Dry matter	8·46	16·195
	Ash [has a decided taste of soda and potash]	0·91	1·742
	Percentage of ash calculated on dry matter,		10.756
	Percentage of organic matter		89·244
JULY 16.	1. *Stalks*	325·50 grs.	
	Water		
	Dry matter		
	Dry	265·00	8·140
	Ash	1·75	0·537
	Calculated dry		6·603
	2. *Sheaths*	251·400	
	Water	239·390	
	Dry	12·010	
	Ash	3·615	1·430
	Calculated dry		11·670
	3. *Leaves*	265·90	
	Water	232·50	
	Dry	33·40	
	Ash	3·44	1·329
	Calculated dry		10·990
JULY 29.	1. *Leaves*	508·00 grs.	
	Water	412·00	
	Dry	96·00	
	Ash	10·25	2·010
	Ash calculated dry		10·680
	Dry matter		19·090
	2. *Sheaths*	383·560	
	Water	336·560	
	Dry	47·000	
	Ash	5·375	1·401
	Ash calculated dry		11·436
	Dry matter		12·230
	3. *Stalk*	892·20	
	Water	817·70	
	Dry	74·50	
	Ash	7·00	0·800
	Ash calculated dry		9·580

TIME.	PARTS.	QUANTITY.	PER CENTUM.
August 4.	1. *Stalk*	1277·00 grs.	
	Water	1141·50	
	Dry	135·50	
	Ash	8·60	0·673
	Ash calculated dry		6·340
	Dry matter		10·610
	2. *Sheaths*	577·00	
	Water	493·60	
	Dry	83·40	
	Ash	8·00	1·380
	Calculated dry		9·597
	Dry matter		14·450
	3. *Leaves*	293·600	
	Dry	57·700	
	Ash	5·615	
	Calculated dry	9·731	
	Dry matter	19·600	
	Per centum		1·812
August 11.	1. *Sheaths*	670·00 grs.	
	Water		
	Dry		
	Ash	10·72	1·600
	2. *Leaves*	508·00	
	Water	347·00	
	Dry	161·00	
	Ash	13·11	2·580
	Calculated dry		8·142
	Dry matter		31·690
	3. *Stalks*	2270·00	
	Water	1864·00	
	Dry	406·00	
	Ash	21·25	0·936
	Calculated dry		5·234
	Dry matter		17·880
	4. *Brush*	463·00	
	Water	273·00	58·980
	Dry	190·00	
	Ash	7·09	1·531
	Calculated dry		3·731
	Dry matter		41·290

TIME.	PARTS.	QUANTITY.	PER CENTUM.
August 22.	1. *Stalk*	1130·000 grs.	
	Water	817·000	71·940
	Dry	313·000	
	Ash	15·375	1·360
	Calculated dry		4·912
	Dry matter		27·600
	2. *Sheaths*	292·50	
	Water	193·55	66·150
	Dry	99·00	
	Ash	6·10	2·092
	Calculated dry		6·161
	Dry matter		33·910
	3. *Brush*	580·50	
	Water	457·50	78·810
	Dry	123·00	
	Ash	5·52	0·937
	Calculated dry		4·487
	Dry matter		21·010
September 1.	1. *Leaves*	193·50 grs.	
	Water	82·50	
	Dry	111·00	
	Ash	5·12	2·652
	Calculated dry		4·612
	Dry matter		57·510
	2. *Sheaths*	285·50	
	Water	162·50	
	Dry	123·00	3·212
	Ash	9·18	
	Ash calculated dry		7·544
	Dry matter		43·080
	3. *Stalk*	1526·00	
	Water	998·00	
	Dry	528·00	
	Ash	20·00	1·310
	Calculated dry		3·787
	Dry matter		34·600
	4. *Brush*	895·00	
	Water	533·00	
	Dry	362·00	
	Ash	14·75	1·647
	Calculated dry		4·072
	Dry matter		40·430

ANAYSES OF THE PARTS BELONGING TO BROOM CORN.

1. *Analysis of the stalks.*

		Removed from the soil in a ton of stalks
Silex	6·24	1·828 lbs.
Earthy phosphates	16·66	4·881
Lime	6·25	1·831
Magnesia	3·74	1·095
Potash	30·40	8·907
Soda	15·46	4·529
Sulphuric acid	9·07	2·657
Chlorine	2·14	0·627
Peroxide of iron	2·61	0·764
Organic matter and magnesia	6·24	1·828
	98·81	28·947

2. *Analysis of the sheaths of the Broom corn.*

		Removed in a ton.
Silica	40·20	28·903 lbs.
Earthy phosphates	15·00	10·785
Lime	3·00	2·157
Magnesia	3·24	2·329
Potash	26·56	19·096
Soda	7·33	5·270
Sulphuric acid	3·57	2·566
Chlorine	1·72	1·236
	100·62	72·342

3. *Analysis of the ripe Broom corn brush, with the seeds.*

		Removed from the soil in a ton of brush and seeds.
Silex	32·50	11·960 lbs.
Earthy phosphates	36·15	13·303
Lime	0·40	0·147
Magnesia	0·10	0·036
Potash	27·32	10·053
Soda	2·37	0·870
Chlorine	2.50	0·846
Sulphuric acid	undetermined.	
	101·14	37·215

4. *Composition of the ash of Broom corn seed.*

Carbonic acid	not determined.
Silicic acid	41·975
Sulphuric acid	not determined.
Phosphoric acid	28·760
Phosphate of peroxide of iron	0·525
Lime	0·845
Magnesia	3·010
Potash	3·920
Soda	7·247
Chlorine	0·245
Organic acids	4·200
	90·727 S.

PROPORTIONS.

Water	12·22
Dry matter	87·78
Ash	3·00
Percentage of ash calculated on the dry matter,	3·417 S.

VIII. BUCKWHEAT.

In its classification as a plant, buckwheat belongs to a family far removed from the cereals; but in the composition and properties of its seed, it approximates to them closely, and hence it is placed here. A few analyses only have been made of it. The two following will show the composition of the ash of the seed. They also show, in the amount of earthy phosphates and phosphoric acid, a remarkable similarity to the grains of the cereals. Its specific gravity is 1·081:

Silica	7·06
Earthy phosphates	57·60
Lime	0·14
Magnesia	2·66
Potash	23·33
Soda	2·04
Sulphuric acid	7·30
Chlorine	0·20
	100·23

The amount of silica may have been increased from want of attention to the foreign matter upon the seed: its well known grittiness, when not removed by a mill, renders the supposition probable.

Composition of the ash of buckwheat.

		Removed in every 10 bushels of seed.
Carbonic acid	trace.	
Silicic acid	1·95	0·245
Sulphuric acid	1·55	0·195
Phosphoric acid	49·85	6·281
Lime	3·01	0·379
Magnesia	15·84	1·995
Potash	21·27	2·680
Soda	2·32	0·292
Chlorine	0·30	0·037
Organic acids	2·75	0·346
	98·84 S.	12·450

	PROPORTIONS.	
Water	12·875	
Dry matter	87·125	
Ash	3·600	
Ash calculated on the dry matter	4·132	S.

Proximate organic analysis of buckwheat.

Starch	42·47
Sugar and extractive matter	6·16
Dextrine or gum	1·60
Epidermis	14·42
A light-gray matter taken up by a weak solution of caustic potash from the bodies insoluble in water and boiling alcohol	10·10
Albumen	6·70
Casein	0·78
Matter dissolved out of the bodies insoluble in water, by boiling alcohol: rising with a substance analogous to water	2·66
Oil	0·47
Water	12·88
	98·24 S.

CHAPTER V.

THE LEGUMINOUS PLANTS.

GENERAL REMARKS ON THIS ORDER OR FAMILY OF PLANTS. THE PROPORTIONS IN WHICH THE ELEMENTS EXIST IN THE BEAN AND PEA: COMPOSITION OF THE ASH. PROXIMATE ORGANIC COMPOSITION OF THE BEAN AND PEA.

The Bean and Pea are regarded as among the important products of the farm and garden. Containing as they do a large amount of nutriment, and being also susceptible of preservation in a dry state for a long time, and under circumstances which would injure the cereals, they supply an important food where it is very much needed, as at sea, and for laborers who are engaged in work which continually wastes the muscles. The bean and pea particularly supply the place of meat. Horses and cattle, however, are not partial to beans; and, indeed, it is not safe to feed beans to horses. Sheep are safely fed with beans: they are regarded as extremely valuable for this kind of stock, and as acting favorably in the development of a large and heavy fleece.

Clover, which belongs to this family of plants, has been spoken of in a former chapter.

It has been impossible to give that time to the examination of this family, which I desired. I have been obliged to confine my attention to a few varieties of beans and peas. This partial and limited account of the composition of a highly interesting family of plants could not well be avoided. What is accomplished, however, may be of some moment, and form an inducement to prosecute researches more extensively in this order.

OF BEANS AND THEIR FOLIAGE.

AUGUST 22.

PROPORTIONS.

1. *Windsor bean leaves and stems.*

Quantity	960·00	grs.
Dry	284·00	
Water	676·00	
Ash	43·87	
Calculated dry	148·00	
Percentage of dry matter		29·50

2. *Windsor bean.*

Quantity	586·00	grs.
Dry	24·00	
Water	562·00	
Ash	9·22	
Ash calculated dry	22·51	
Percentage of dry matter		4·09

AUGUST 6.

3. *Small round field bean stems* (Plants one-fourth grown).

Quantity	100·00	grs.
Water	80·75	
Dry	19·25	
Ash	1·90	
Ash calculated dry	9·87	

4. *The leaves of the same variety.*

Quantity	100·00	grs.
Water	83·00	
Dry	15·56	
Ash	3·08	
Ash calculated dry	18·599	

ANALYSIS OF BEANS.

5. *Stems and leaves of the Windsor bean.*

		Removed in a ton of bean straw.
Silica	35·10	35·907 lbs.
Earthy phosphates	13·65	13·452
Lime	28·125	28·771
Magnesia	trace.	
Potash	16·030	16·398
Soda	trace.	
Sulphuric acid	1·005	1·028
Chlorine	2·315	2·368
	95·725	97·924

6. *Pod of the Windsor bean.*

Silica	4·500
Phosphates	26·000
Lime	22·500
Magnesia	2·420
Potash	19·440
Soda	11·260
Sulphuric acid	2·600
Chlorine	1·160
Organic matter	2·300
Carbonic acid	5·453
	97·506

7. *White Kidney bean.*

Silica	0·80
Earthy and alkaline phosphates	30·95
Lime	0·35
Magnesia	0·45
Potash	35·04
Soda	2·42
Sulphuric acid	4·98
Chlorine	0·52
Organic matter	6·60
Carbonic acid	18·85
	100·96

Bean ash always contains more or less of carbonic acid. As it effervesces briskly with acids; so, the amount of organic matter seems to be greater than in other kinds of ash. The bean burns without difficulty, and furnishes a white ash in lumps of the size and

shape of the bean itself; and it is rather remarkable that, where so much potash exists, the consumption should take place with very little danger of fusion; while in the cereals, the greatest difficulty is encountered in combustion, and the ash will fuse at a low temperature. This fact is probably owing to the state of combination of the elements, and to the presence of a large amount of alkaline phosphates which fuse very readily.

8. *A large white bean, the large white English or Butterfield bean.*

Furnished by Judge PETERS, of Genesee county.

Silica	0·275
EARTHY PHOSPHATES:	
Lime	3·145
Magnesia	6·620
ALKALINE PHOSPHATES:	
Potash	0·095
Soda and phosphoric acid	18·865
Lime	0·042
Magnesia	trace.
Potash	39·946
Soda	6·866
Phosphate of peroxide of iron	0·525
Chloride of sodium	0·265
Sulphuric acid	2·955
Carbonic acid	5·400
Organic matter	undetermined.
	84·825 S.

9. *Pods of the same kind of bean.*

Silica	28·925
EARTHY PHOSPHATES:	
Phosphate of peroxide of iron	0·075
Lime	0·360
Magnesia	8·770
Silicic acid	0·125
Phosphoric acid	14·135
Lime	13·975
Magnesia	0·815
Potash	19·975
Soda	4·007
Chloride of sodium	0·580
Sulphuric acid	0·034
Carbonic acid	6·200
Organic matter	undetermined.

10. *Vines of the same variety of bean.*

Silica	21·575
Earthy Phosphates:	
Lime	5·825
Magnesia	3·286
Phosphate of peroxide of iron	3·825
Phosphoric acid	9·935
Silicic acid	trace.
Lime	5·062
Magnesia	0·055
Potash	7·053
Soda	36·194
Chloride of sodium	0·118
Sulphuric acid	0·464
Carbonic acid	4·450
Organic matter	undermined.
	97·944 S.

ANALYSES OF THE ASH OF SEVEN VARIETIES OF BEANS.

1. *White Kidney bean.*

		Per centum.
Quantity	400·00 grs.	
Dry	347·00	
Water	53·00	13·250
Ash	12·09	3·020
Ash calculated dry		13·930

2. *Refugee*, or 1000-*to*-1 *bean.*

Quantity	400·000 grs.	
Dry	354.000	
Water	46·000	11·500
Ash	14·625	3·650
Ash calculated dry		16·490

3. *Field-pea bean.*

Quantity	400·00 grs.	
Dry	348·00	
Water	52·00	13·000
Ash	12·63	3·157
Ash calculated dry		

		Per centum.
4. *Turtle-soup bean.*		
Quantity	400·00 grs.	
Dry	298·40	
Water	101·60	25·400
Ash	12·35	3·087
Ash calculated dry		16·650
5. *Horticulturist bean.*		
Quantity	400·00 grs.	
Dry	355·50	
Water	44·50	11·125
Ash	15·74	3·935
Ash calculated dry		17·710
6. *Early China bean.*		
Quantity	400·00 grs.	
Dry	359·00	
Water	41·00	
Ash	16·59	1·025
Ash calculated dry		4·147
7. *Early Mohawk bean.*		
Quantity	400·00 grs.	
Dry	347·00	
Water	53·00	14·250
Ash	12·69	3·172
Ash calculated dry		

Composition of the inorganic matter of the seven foregoing varieties of beans.

The ash of all the varieties contains carbonic acid.

1. *White kidney bean.*

		Calculated without carbonic acid or organic matter.
Silica	1·100	1·222
Earthy phosphates	40·850	45·384
Lime	0·021	0·023
Magnesia	0·010	0·011
Potash	31·625	35·135
Soda	11·135	12·320
Sulphuric acid	3·785	4·205
Chlorine	trace.	
Carbonic acid	8·401	
(		

2. *Refugee, or* 1000-*to*-1 *bean.*

		Calculated without carbonic acid.
Silica	2·400	2·476
Earthy phosphates	45·700	47·162
Lime	trace.	
Magnesia	0·020	0·020
Potash	33·270	34·334
Soda	10·800	11·145
Sulphuric acid	3·510	3·622
Chlorine	trace.	
Carbonic acid	3·210	
	98·890	98·759

3. *Field-pea bean.*

		Calculated without carbonic acid or organic matter.
Silica	2·125	2·454
Earthy phosphates	30·500	35·227
Alkaline phosphates	4·400	5·082
Lime	trace.	
Magnesia	none.	
Potash	29·285	33·824
Soda	13·105	15·136
Sulphuric acid	6·535	7·547
Chlorine	trace.	
Carbonic acid	10·235	
Organic matter	5·312	
	97·107	99·270

4. *Turtle-soup bean.*

Specific gravity, 1·242.

		Calculated without carbonic acid or organic matter.
Silica	2·900	3·204
Earthy phosphates	27·950	30·884
Alkaline phosphates	9·100	10·055
Lime	0·200	0·221
Magnesia	trace.	
Potash	19·610	21·669
Soda	24·250	26·769
Sulphuric acid	5·500	6·077
Chlorine	none.	
Carbonic acid	6·571	
Organic matter	2·000	
	98·081	98·879

The Turtle-soup bean is particularly excellent for soups, having the rich flavor of the green turtle soup. Whether this quality is connected with the composition of the ash, is not easily determined : it however contains much soda and less potash than other varieties. It is worthy of notice, too, that the soda of beans is not in combination with chlorine, but probably with sulphuric acid.

5. *Horticulturist bean.*		Calculated without carbonic acid or organic matter.
Silica	0·200	0·219
Earthy phosphates	31·875	34·935
Alkaline phosphates	3·750	4·110
Lime	trace.	
Magnesia	trace.	
Potash	38·080	41·735
Soda	11·475	12·574
Sulphuric acid	4·340	4·756
Chlorine	0·010	0·010
Carbonic acid	8·400	
Organic matter	1·200	
	96·130	98·339

6. *Early China bean.*		Calculated without carbonic acid.
Silica	1·655	1·820
Earthy phosphates	32·956	36·251
Alkaline phosphates	2·756	3·031
Lime and magnesia	traces.	
Potash	37·421	41·163
Soda	10·256	11·281
Sulphuric acid	5·470	6·017
Chlorine	traces.	
Carbonic acid	8·410	
Organic matter	1·620	
	100·544	99·563

7. *Early Mohawk bean.*		Calculated without organic matter or carbonic acid.
Silica	0·200	0·230
Earthy phosphates	33·800	38·870
Alkaline phosphates	2·500	1·875
Lime and magnesia	traces.	
Potash	34·050	39·157
Soda	8·845	10·171
Sulphuric acid	4·725	5·433
Chlorine	0·430	0·494
Carbonic acid	13·860	
Organic matter	1·210	
	99·620	97·230

It appears from the foregoing analyses, that the ashes of the several varieties of bean differ somewhat; the greatest deviation from the majority of them being in the Turtle-soup bean. The ash varied somewhat in the degree of causticity, or in the amount of carbonic acid. The ash, in each instance, was perfectly burned and white. There is a great resemblance between the composition of the ash of beans and that of the cereals, in respect to their richness in earths, alkalies and phosphates.

The exhausting power of a crop of beans may be determined by the following calculations. A bushel of beans weighs about 60 lbs. There will be removed in every ten bushels of beans:

	Turtle-soup bean.		*Horticulturist bean.*	
	lbs.	oz.	lbs.	oz.
Silica	0	8·584	0	0·755
Earthy phosphates	2	2·732	7	8·360
Alkaline phosphates	1	10·936	0	14·160
Lime	0	0·592		
Magnesia				
Potash	3	10·045	8	15·790
Soda	4	7·780	2	11·329
Sulphuric acid	1	0·280	1	0·387
Chlorine			0	0·037
	16	8·949	21	2·818

There will be removed in a ton of foliage:

	lbs.	oz.
Silica	14	15·341
Earthy phosphates	15	12·861
Lime	3	7·965
Magnesia	0	0·608
Potash	4	13·977
Soda	25	0·160
Sulphuric acid	0	5·129
Chlorine	0	1·304
	64	9·345

Beans, although put upon what is regarded the barren soils, still make shift to supply themselves with the richest and most valuable constituents of the soil; and hence they may be regarded as an exhausting crop. The plan of starving the bean is, after all, the true mode of treating it, otherwise it would become strong and unpalatable.

PROXIMATE ORGANIC ANALYSES OF THREE VARIETIES OF BEANS.

1. *Field pea-bean.*

Starch	14·68
Legumine	20·00
Albumen	0·97
Casein	2·21
Fibre	30·71
Resinous matter	4·50
Extractive matter	12·20
Water	13·00
	98·27

2. *White Kidney bean.*

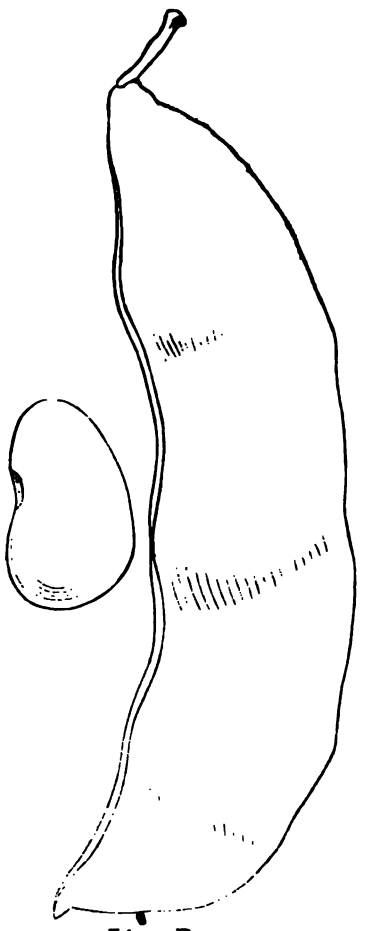
Starch	36·74
Legumine	18·60
Albumen and casein	9·92
Fibre	15·42
Sugar and extract	7·20
Water	13·25
	101·13

3. *Refugee*, or 1000-*to*-1 *bean.*

Starch	30·20
Legumine	17·44
Albumen and casein	8·40
Fibre	21·22
Sugar and extract, mostly extract	6·75
Water	11·50
	95·51

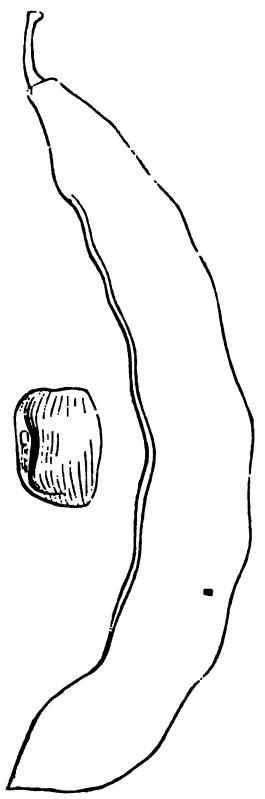
The starch is separated from the bean meal by washing and subsidence; albumen by heat, and casein by acetic acid, which, however, does not exist except in small quantities. The remainder is evaporated to dryness, and the dry matter washed with a large quantity of alcohol, which dissolves the resinous, extractive matter and sugar. The remainder, which is insoluble in alcohol, is set down as legumine after drying in the water bath.

Fig. 1.



Lima Bean.

Fig. 2.



Butter Bean.

These LIMA and BUTTER beans were premium specimens of those varieties, which were exhibited at the Horticultural Exhibition of the Albany and Rensselaer Counties Society. The first was a very fine and perfect sample of the variety.

The Butter bean is a beautiful bush bean, having a fine blue color, and, as its name implies, is very rich and nutritive. It is not extensively cultivated, but well deserves to replace some of the older varieties. The plant, it will be observed, breaks up into numerous varieties, each of which is marked by distinct characters. In fact the varieties of bean are more distinct than those of other plants.

ANALYSES OF THE PEA (Pl. 48).

PROPORTIONS.

1. *Early June pea vine.*

	Quantity.	Per centum.
1. *Bottom of the vine*	89·00 grs.	
Dry	22·00	
Water	67·00	
Ash	2·28	2·55
2. *Top*	100·00	
Dry	22·30	
Water	77·70	
Ash	1·20	1·20
3. *Leaf*	100·00	
Dry	24·60	
Water	75·40	
Ash	2·15	2·15
4. *Pods*	100·00	
Dry	10·11	
Water	89·89	
Ash	1·43	1·43
5. *The Pea*	100·00	
Dry	30·70	
Ash	1·12	1·12

2. *Vetch vines*, or *small wedgeform pea.*

Quantity	100·00 grs.	
Dry	25·00	
Water	75·00	
Ash	1·45	1·45

3. *Analysis of the ash of the small wedgeform pea.*

Silica	4·30
Earthy phosphates	38·40
Lime	0·10
Magnesia	0·96
Potash	27·95
Soda	3·57
Sulphuric acid	8·72
Carbonic acid	13·39
Organic matter	3·20
	100·59

This variety of [illegible]ised for
is there held in esteem.

4. *Proximate organic analysis of the green June pea.*

Quantity - - - - - - - - -	150·00 grs.
Starch - - - - - - - - -	11·78
Albumen - - - - - - - -	3·57
Casein - - - - - - - - -	0·18
Fibre - - - - - - - - -	9·34
Residue containing legumine, sugar and extract,	20·00
Water - - - - - - - - -	105·00

The starch exists in the pea when it is green. When ripened, its elements are changed; the starch disappears mostly, and legumine may be said to take its place. The above analysis is quite imperfect, and is taken from the notes mainly to show the amount of starch when the plant is in its green state.

CHAPTER VI.

THE ESCULENT VEGETABLES.

I. THE CABBAGE TRIBE.

This natural tribe of plants are distinguished botanically by their tetradynamous flowers, and chemically by containing a large amount of nitrogen, which, during their decomposition, is manifested by exhaling an odor closely resembling decaying animal matters. Medicinally they possess what is called antiscorbutic and stimulant qualities. So strongly stimulant are some of these plants, or parts of them, that unless this character is obtunded by mucilage, they become useless as food for man. In the cabbage, turnip, cress and radish, this stimulating principle is shielded by mucilage. The seeds are remarkable, too, for the great amount of sulphur which they contain, amounting in some cases to nearly 30 per centum. Oil is one of their most valuable products: that of the rape is well known, and is in general use, both as a manure, and for feeding cattle.

The analyses which have been made in the laboratory for the Survey, have been confined to the cabbage mostly: they were undertaken by Mr. Salisbury, and have been carefully executed. A statement of these analyses has been given in the American Journal of Agriculture and Science, and it is from this source that the following determinations are compiled. For a full account, the reader may consult the work just referred to.

ANALYSES AND EXAMINATION OF FIVE VARIETIES OF CABBAGE.

1. *The Scotch, Strasburgh* or *Drum-head cabbage.*

Head compact, yellowish-green without and blanched within. Furnished by Mr. J. B. Hutson of Albany.

	PROPORTIONS.
	100·00 parts gave
Water - - - - - - - - -	88·665
Dry matter - - - - - - - -	11·335
Ash - - - -	
Ash calculated dry -	

The proportions of its proximate organic elements are as follows:

		Calculated without the water.
Sugar and extractive matter, accompanied with the substance which imparts the peculiar cabbage odor	9·32	55·977
Oil and wax	0·16	·962
Fibre with a little starch and chlorophyl	0·94	5·646
Fibre	2·16	12·974
Matter dissolved by potash from the fibre (albumen)	0·88	5·281
Albumen	1·74	10·461
Casein	0·36	2·157
Dextrine	1·09	6·542
Water	83·42	
	100·07	98·190 S.

The produce of an acre may be estimated by taking 15 lbs. as the average weight of each plant, and assuming that it will occupy a square yard. An acre will produce, according to the estimate, 36 tons, containing 30 tons of water and 6 tons of dry matter. The nitrogenous matter of an acre, according to the foregoing calculation, will be 357·6 lbs. in the green plant, and 2148 lbs. in the dry. A ton of the green plant contains 15·8 lbs. of inorganic matter, and 139·38 lbs. in the dry plant. There will be removed from an acre, 569 lbs. of inorganic matter. A ton of the green plant contains 1768 lbs. to 232 of dry matter.

2. *Analysis of the ash of the Drum-head cabbage, with a statement relative to its exhausting power.*

	Per centum.	Elements in a ton.	Elements removed from an acre.	Calculated without water, carbonic acid and organic matter.
Silica	0·550	0·550 lbs.	2·958 lbs.	0·767
Phosphoric acid	11·870	1·876	63·784	16·544
Lime	2·698	0·426	14·484	4·662
Magnesia	3·345	0·529	17·986	1·533
Phosphate of perox. of iron,	1·100	0·174	5·916	3·761
Potash	20·078	4·172	142·448	27.985
Soda	30·116	4·758	161·772	41·976
Sulphuric acid	10·449	1·651	56·134	14·564
Chlorine	0·741	0·117	3·978	1·033
Organic acids	4·805			
Carbonic acid	13·500			
	99·252 S.	14·253	469·460	112·825

3. *Analysis of the large yellow Savoy cabbage.*

Gardeners distinguish 3 sub-varieties: the Large yellow, the Dwarf, and the Green. Leaves crisped; stalks short and thick; weight from 4 to 10 lbs. Furnished by Mr. Huston.

	PROPORTIONS.	
	100·000	parts gave
Water	86·525	
Dry	13·475	
Ash	0·890	
Ash calculated dry	6·605	S.

The proximate organic elements obtained from this cabbage were as follows:

		Calculated without water.
Sugar, and the odorous matter of cabbage	8·60	46·386
Oil and wax	0·26	1·402
Fibre, starch and chlorophyl	2·47	13·323
Pure fibre	2·41	12·999
Matter soluble in potash	1·31	7·066
Albumen	2·05	11·057
Casein	0·40	2·158
Dextrine	1·04	5·609
Water	81·23	
	99·77	100·000 S.

Composition of the ash of the Savoy cabbage.

		Amount of elements in a ton of dry cabbage.
Silica	1·100	1·453 lbs.
Phosphoric acid	20·825	27·510
Lime	0·906	1·197
Magnesia	4·760	6·288
Phosphate of peroxide of iron	1·050	1·387
Potash	17·525	23·151
Soda	23·366	30·867
Sulphuric acid	15·811	20·886
Chlorine	1·974	2·608
Organic matter	3·260	
	90·577 S.	115·347

4. *Analyses of the Red cabbage* (Sub-var. *rubra*).

Gardeners also distinguish 3 sub-varieties : the Large red or Red Dutch, the Dwarf, and the Aberdeen red.

PROPORTIONS.

	100·000 parts gave
Water	87·915
Dry	12·085
Ash	0·930
Calculated dry	7·695 S.

ANALYSIS.

		Calculated without water.
Sugar and extractive matter	8·70	51·479
Oil and wax	0·12	0·710
Fibre, starch and coloring matter	1·20	7·101
Pure fibre	2·98	17·134
Dissolved by potash (albumen)	0·19	1·124
Albumen	1·83	10·828
Casein	0·72	4·260
Dextrine	1·16	6·864
Water	83·35	
	100·25 S.	99·500

With the same assumptions as in the first variety noticed, the produce of an acre will be 24·2 tons, allowing the heads to average 10 lbs. Of this quantity, 20·2 tons will be water, and 4 dry cabbage, of which a ton will contain 324 lbs. of nitrogenous matter, and only 54·8 lbs. in the green state. A ton of the green plant will contain 18·6 lbs. of inorganic matter; the dry, 153·9 lbs.; and an acre will be deprived of 446 lbs. according to these calculations.

The ash contains the following amount of elements in 100 parts:

		Elements in a ton of dry cabbage.
Silica	3·350	5·156 lbs.
Phosphoric acid	10·110	15·559
Lime	2·869	4·415
Magnesia	3·350	5·433
Phosphate of peroxide of iron	3·600	5·541
Potash	20·203	31·093
Soda	26·937	41·456
Sulphuric acid	14·849	22·853
Chlorine	0·987	1·519
Organic matter	5·050	
Carbonic acid	8·600	
	100·185	113·025 S.

5. *Analysis of the Cauliflower cabbage* (Sub-var. *botrytis*).

From the garden of Mr. Douw of Greenbush.

	PROPORTIONS. 100·000 parts gave
Water	85·700
Dry	14·300
Ash	1·520
Calculated dry	10·629 S.

Head consisting of flower buds and pedicels.

Sugar and extractive matter, and the odorous matter of the species	8·08
Fibre and starch	0·63
Fibre	1·76
Wax and chlorophyl	0·34
Soluble in potash	2·19
Albumen	0·94
Casein	0·05
Dextrine	1·74
Water	85·70
	101·43 S.

Composition of the ash.

		A ton of dry cabbage contains.
Silica	1·25	2·652 lbs.
Phosphoric acid and peroxide of iron	28·65	60·904
Lime	0·73	1·542
Magnesia	2·16	4·592
Potash	18·41	39·136
Soda	33·44	71·087
Sodium	0·20	0·425
Sulphuric acid	9·79	20·812
Chlorine	0·30	0·638
Organic matter	3·05	
Carbonic acid	1·85	
	99·83	201·788 S.

6. *Examination of the Turnip-rooted cabbage* (Sub-var. *caulo-rapa*).

Furnished by Mr. Douw.

PROPORTIONS.

	100·000 parts gave
Water	91·140
Dry	8·860
Ash	0·805
Calculated dry	9·086 S.

ANALYSIS.

Sugar and extractive matter, with the odorous matter of cabbage	4·880
Starch and fibre	0·285
Fibre	1·560
Soluble in potash	0·650
Albumen	0·655
Casein	0·570
Dextrine	1·190
Water	91·140
	100·930 S.

Composition of the ash.

		Elements in a ton of dry cabbage.
Silica	0·675	1·228 lbs.
Phosphoric acid and peroxide of iron	16·925	30·802
Lime	3·380	6·156
Magnesia	1·875	3·410
Potash	21·575	39·266
Soda	27·840	53·668
Sodium	1·395	2·538
Sulphuric acid	9·970	18·145
Chlorine	2·120	2·538
Organic matter	3·525	
Carbonic acid	8·850	
	98·130	157·751 S.

I commenced an examination of the turnip, its top or leaves and root, but it remains unfinished from want of time. The leaves contain in 500 parts 85·92 of dry matter and 415·08 water, or 17·18 per centum of dry matter; ash 13·69, or 2·73 per centum of inorganic matter. Of this 13·69, 3·69 is silica, 2·35 earthy phosphates, 1·25 carbonate of lime, ·615 magnesia, 1·26 potash, and 3·73 soda. The composition was influenced by an unmanured soil, and by a small quantity of adherent foreign matter.

7. A complete analysis of the ash of turnip tops, according to Mr. R. M'CALMONT, furnishes the following result:

Silica	1·39
Phosphoric acid	9·22
Lime	22·98
Magnesia	2·87
Oxide of iron	0·42
Potash	16·42
Chloride of potassium	9·61
Chloride of sodium	6·65
Sulphuric acid	16·31
Carbonic acid	13·18
	99·05

Turnip tops furnish a food for horses and cattle, superior to the root. Whether the tops give an unpleasant flavor to the milk of cows, I am not particularly informed.

To the husbandry of New-York, turnips are not so essential as they are in England: that they constitute a valuable addition to the resources of the farmer is well established, even if it were for no other purpose than to furnish a variety to the food of stock.

The turnip root gave the following proportions:

	1000·00 parts gave
Dry	97·30
Ash	7·50

8. *Analysis of the Sugar beet.*

	1000·00 parts gave
Dry	132·71
Ash	5·00*

*Journal of Agriculture, and the Transactions of the Highland and Agricultural Society of Scotland, for October, 1847.

II. THE SQUASH TRIBE.

1. *Analyses of two varieties of Squash and one of Pumpkin.*

	PROPORTIONS.	Per centum
1. *Vegetable Marrow*, *Boston Marrow* (Pl. 4, fig. 1),	1000·000 grs.	
Dry	124·905	12·490
Water	875·095	
Ash	7·220	0·722
2. *Custard squash* (Pl. 6, fig. 1)	1000·000 grs.	
Dry	76·760	
Water	923·240	92·320
Ash	4·875	0·487
3. *Pumpkin*	1000·000 grs.	
Dry	70·100	
Water	929·900	92·990
Ash	5·490	0·549

The amount of water in the three foregoing vegetables, as will be seen, is large, a fact with which all who observe are familiar. The amount of ash is small; and its constitution is not very unlike that of the cereals and of the edible tuberous plants, except that soda is in a great excess over the potash, if a single analysis is sufficient for establishing a fact.

The squash and the pumpkin, like all other domesticated plants, form numerous varieties, which differ in external form and color; and what is far more interesting, is their differences in composition also; differences, which, though they may not separate the varieties far from each other, yet are so considerable that analysis readily discovers the fact. Each seems to possess its own powers of appropriating nutriment, in a manner which has been already pointed out in regard to varieties of maize growing upon the same ear. This fact may have been acknowledged in some instances, yet I am not aware that it has been very distinctly asserted before, and upon a sufficient authority, or based upon well ascertained facts. Neither has it been stated that a great similarity exists between the edible tubers, the cereals, and the esculents, those which are so highly esteemed and in almost universal use.

2. *Analysis of the ash of the Vegetable Marrow squash.*

Silica	2·000
Coal	0·020
Earthy phosphates	31·200
Alkaline phosphates	3·300
Lime	0·200
Magnesia	0·001
Potash	8·980
Soda	33·140
Sulphuric acid	5·510
Chlorine	6·160
Organic matter	3·140
Carbonic acid	3·780
	97·620

3. *Proximate organic analysis of the Vegetable Marrow squash.*

Quantity	200·000 grs.
Starch	1·594
Fat	0·206
Fibre	6·855
Albumen	2·730
Dextrine	2·390
Sugar	15·400
Water	175·020
	199·191

4. *Proximate organic analysis of the Butter squash.*

Starch	none.
Fat	undetermined.
Fibre	6·065
Albumen	2·215
Dextrine	0·250
Sugar and extract	23·380
Water	189·660
	200·520

In the product sugar and extract, it was sensible to the taste that the Butter squash was less sweet than the Vegetable Marrow. In cooking, and in analysis, the former is superior to the latter.

5. *Proximate organic analysis of the fruit of the Egg plant* (Pl. 7).

Sweet matter, extract, and a small quantity of a bitter principle	3·040
Starch with a little chlorophyl	0·365
Albumen	0·255
Casein	9·200
Dextrine	0·370
Fibre	0·760
Matter dissolved out of fibre by a weak solution of caustic potash	0·975
Water	91·353
	97·318 S.

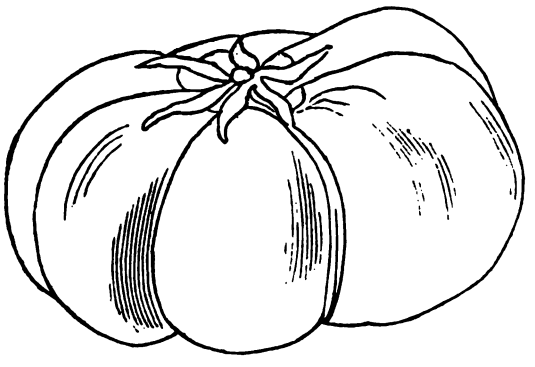
PROPORTIONS.

Water	91·353
Dry matter	8·647
Ash	0·604
Ash calculated on the dry matter	6·981 S.

The Egg plant (*Solanum melongena*) is a valuable species, bearing a large purple fruit upon a prickly stem. It is fleshy, though rather watery; yet when fried in butter, it resembles very tender meat in flavor. It is a delicacy which is far less common than might be expected. A single berry sells for one shilling. The plant is an annual, herbaceous and branching : it grows two feet high. It may be prepared for food in various ways, and is considered as wholesome and delicious. Like the tomato, it is cultivated from the seed, which must be sown early in a warm dry mellow soil.

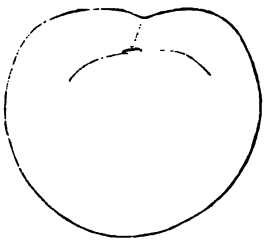
The Tomato (*Solanum lycopersicum*) has been noticed already in connection with the potato. This species has increased greatly in esteem during the last ten years. It is now

Fig. 3.



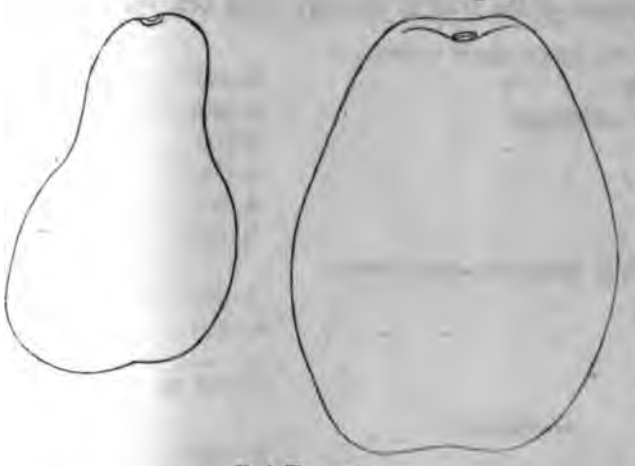
Red Tomato.

Fig. 4.



Yellow Tomato.

Fig. 5. Fig. 6.

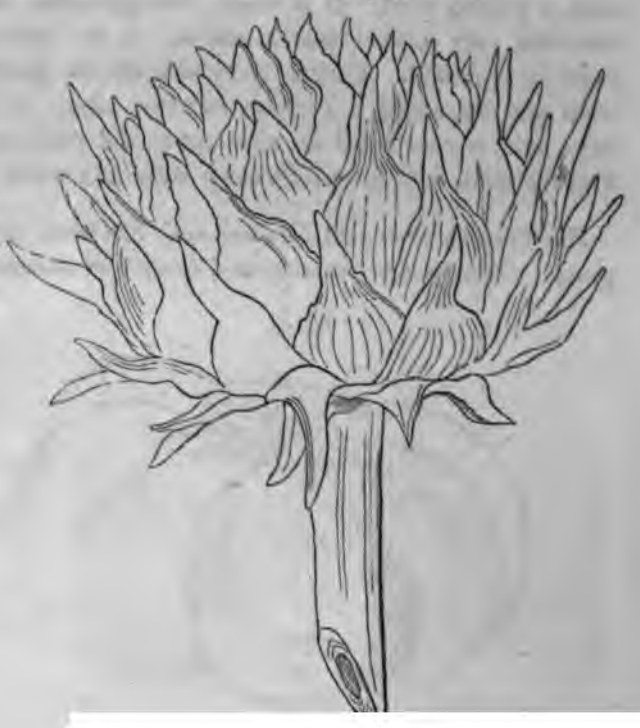


Red Tomatoes.

constant in the markets, and sells for a high price. The plant bears a large amount of fruit when well manured. The fruit is at first of a green color, and becomes red or yellow when ripe. It runs into numerous varieties by cultivation: the large red-lobed or torulose variety is one of the best. Some of the varieties are figured as in figs. 3, 4, 5, 6. The small round yellow fig. 4 is a beautiful berry, and is less acid than the large fig. 3.

The tomato is eaten in various ways, as raw and mixed with sugar, or fried, etc. Added to soup in proper quantities, it greatly improves it. It is also pickled. It may be dried in the sun, or in an oven, and kept for winter's use.

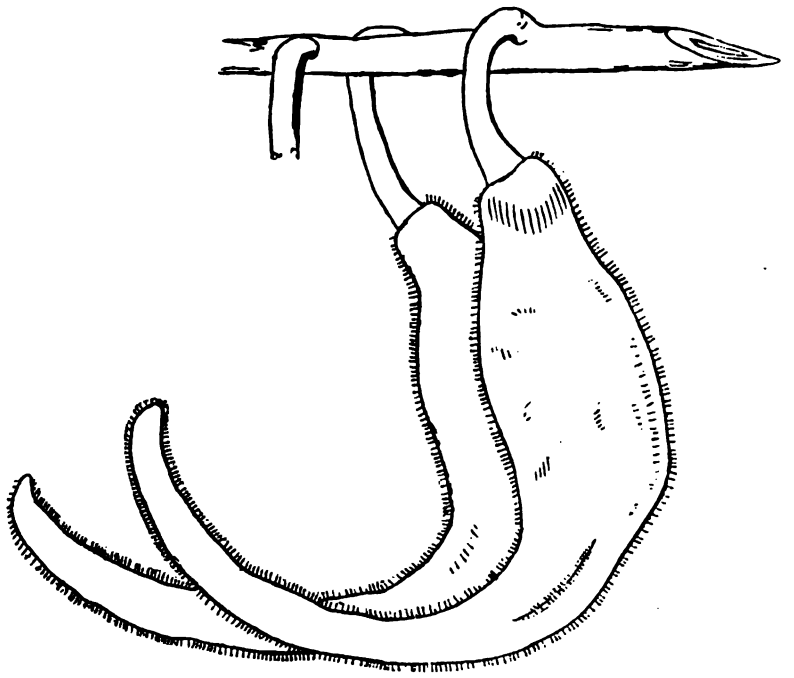
Fig. 7.



The Artichoke, fig. 7 (*Cynara colymus*), takes its name from the stiff hard spines of the head (which is much like a thistle), and which resemble the teeth of a dog. As spiny as the head appears, it is still regarded with favor, and is prepared for the table. The fleshy receptacle and interior part of the plant, and the upper part of the stalk, on being boiled and well buttered, furnish a very savory dish. It is a native of Europe, but has become naturalized here. It is cultivated from suckers planted in rows, and about three feet apart. It flowers in September or late in August.

The MARTYNIA (fig. 8) is a strong-smelling vegetable, the capsules and calyx of which are prolonged into thick and fleshy hooks. In its green state, these parts are esteemed for pickles : when too old, or when the seed has ripened, it becomes woody, tough, and useless. It serves to increase the variety of condiments, and may become of some importance, inasmuch as the plant is very easy to cultivate, and is frequently found growing spontaneously by roadsides.

Fig. 8.



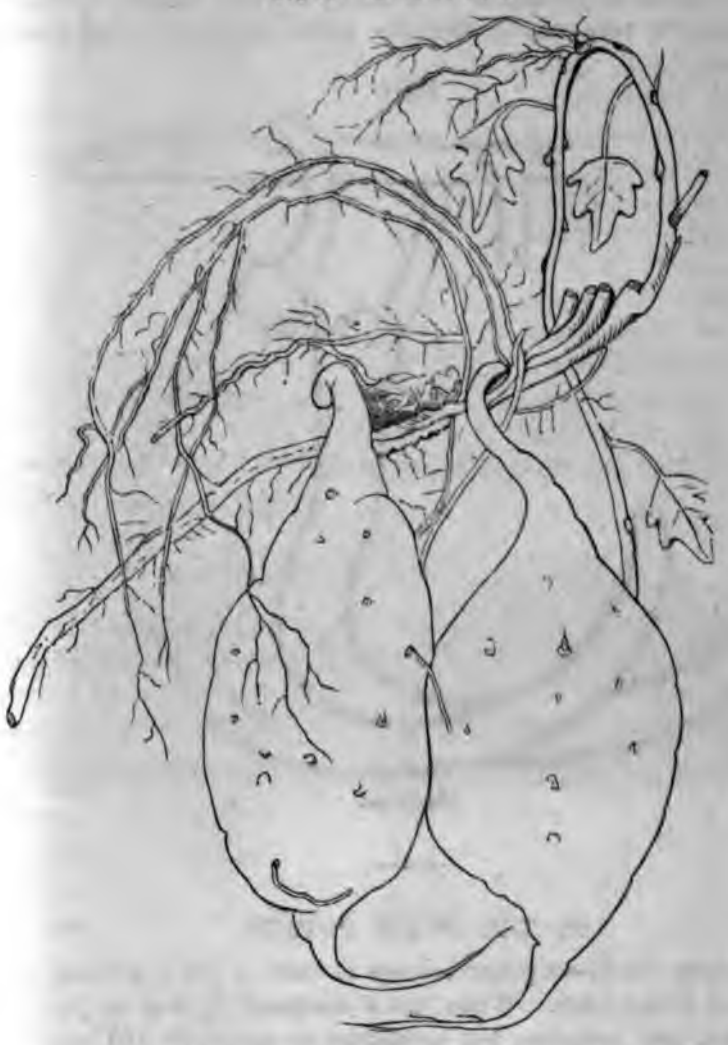
Martynia.

III. THE SWEET POTATO.

The family to which the Sweet potato belongs is more or less poisonous, from the presence of an acrid or milky juice. When this is dissipated by heat or drying, the fleshy tuberous part is not only harmless, but constitutes an agreeable and nutritious food, in which starch is one of the most abundant constituents. Jalap and scammony, drastic purgatives, belong to the same genus as the Sweet potato. The most valuable species of this family all belong to the tropics; and none, I believe, are found within the frigid zone. With care and proper management, the Sweet potato may be grown for the table in the vicinity of Albany. In New-Jersey they are cultivated with great success, and supply the demands in a great measure of the markets of New-York, and the cities and villages upon the Hudson river.

The foliage of the Sweet potato is a slender, leafy, climbing vine: the roots or tubers appear large, and out of proportion to the foliage.

Fig. 9. — *Sweet Potato.*



ANALYSES OF THE SWEET POTATO.

Cut when ripe, and furnished by Mr. SEARS, of the North American Phalanx, N. Y. Soil sandy and light.

	PROPORTIONS.	Percentage.
1. TOP - - - - - - - - -	1065·400 grs.	
Dry - - - - -	225·000	
Water - - - - -		
Ash - - - - -		

		Percentage.
2. Stem	100·000 grs.	
Dry	21·800	
Water	78·200	
Ash	1·735	
3. Leaves	100·000	
Dry	20·400	
Water	79.600	79·600
Ash	2·630	2·630
4. Tubers:		
1. *Outside*	658·000	
Dry	175·200	26·624
Water	482·800	5·150
Ash	3·390	1·934
2. *Inside*	878·000	
Dry	264·000	
Water	614·000	
Ash	3·650	0·415
Ash calculated dry		1·376
Dry matter		30·125
3. *Middle*	1950·000	
Dry	604·000	
Water	1346·000	
Ash	8·650	0·443
Ash calculated dry		1·432
Dry matter		30·974
4. *Bottom*	2158·000	
Dry	504.000	
Water	1654·000	
Ash	13·220	0·612
Ash calculated dry		2·623
Dry matter		23·354

1. *Analysis of the leaves and stems.*

Silica	23·600
Earthy phosphates	28·575
Carbonate of lime	15·000
Magnesia	none.
Potash	18·515
Soda	9·460
Sulphuric acid	2·785
Chlorine	2·090
	100·025

2. *Analysis of the tubers.*

Silica	1·850
Earthy phosphates	21·100
Carbonate of lime	0·600
Magnesia	0·500
Potash	48·365
Soda	5·025
Sulphuric acid	1·200
Chlorine	4·090
Organic matter	2·456
Carbonic acid	15·725
	98·911

It will be seen, by comparing the amount of potash in the Sweet potato with that in the common potato, that a very close resemblance exists between them in the amount of potash. There is also the same close resemblance in the percentage of the ash; but it is proper to remark that the percentage of ash may be rather low, on account of its easy fusibility and its liability to causticity.

3. *Proximate organic analysis of the Sweet potato.*

Starch	19·955
Sugar and extractive matter, mostly sugar	5·800
Dextrine	0·750
Fibre after boiling in a weak solution of caustic potash	1·850
Matter dissolved out of fibre by a weak solution of caustic potash	2·100
Albumen	5·900
Casein	1·050
A body that resembles balsam	0·225
Water	69·515
	101·835 S.

PROPORTIONS.	Per centum.
Water	69·515
Dry matter	30·485
Ash	1·090
Ash calculated on the dry matter	3·247 S.

CHAPTER VII.

MISCELLANEOUS ANALYSES.

ANALYSES OF FLAX, FLAXSEED, AND HEMP.

	PROPORTIONS.
1. *Sun-dried flax* - - - - - - -	100·00 grs.
Dry - - - - - - - -	91·42
Water - - - - - - - -	8·58
Ash - - - - - - - -	1·80
2. *Flaxseed* - - - - - - -	100·00
Dry - - - - - - - -	92·72
Water - - - - - - - -	7·28
Ash - - - - - - - -	3·70

1. *Analysis of the straw and fibre.*

Soil based upon Taconic slate, and formed of round and slaty gravel and clay loam.

		Removed in a ton of straw.
Silica - - - - - - - -	7·500	2·272 lbs.
Earthy phosphates - - - - -	23·225	7·037
Carbonate of lime - - - - -	25·400	7·696
Magnesia - - - - - - -	2·680	0·812
Potash - - - - - - - -	25·870	7·838
Soda - - - - - - - -	7·835	2·374
Sulphuric acid - - - - - -	3·440	1·042
Chlorine - - - - - - -	0·440	0·133
Organic matter - - - - - -	2·130	
	98·530	29·204

2. *Analysis of flaxseed.*

		Removed in every 100 lbs. of seed.
Silica - - - - - - - -	8·00	0·666
Earthy phosphates - - - - -	47·50	1·757
Carbonate of lime - - - - -	0·20	0·007
Magnesia - - - - - - -	0·10	0·003
Potash - - - - - - - -	18·09	0·669
Chloride of sodium - - - - -	20·09	0·743
Sulphuric acid - - - - - -	7·56	0·279
Chlorine - - - - - - -	trace.	
	101·54	4·124

Flax and hemp are exhausting crops: the earthy phosphates, lime and the alkalies, form important elements in the plants.

3. *Analysis of hemp.*

Silica	12·00
Earthy phosphates	36·50
Carbonate of lime	25·90
Magnesia	4·50
Chloride of sodium	1·00
Potash	15·00
Soda	3·30
Sulphuric acid	1·50
	99·70

From the foregoing analyses, it is evident that both flax and hemp are exhausting crops. They have too the disadvantage in cultivation, that usually nothing is returned to the soil. The ash of the straw might, however, be scattered over the soil, though it is rarely if ever done.

ANALYSIS OF SPEARMINT.

Stem and leaves nearly dry.

PROPORTIONS.

Dry plant	100·00
Dry	98·00
Ash	2·72

ANALYSIS.

Silica	13·00
Earthy phosphates	24·15
Carbonate of lime	23·50
Magnesia	0·62
Potash	24·20
Soda	3·40
Chlorine	4·20
Sulphuric acid	3·40
Organic matter	1·50
	97·97

The herbage of spearmint and peppermint, as is well known, is used for the oil they contain. The latter is cultivated exte
neous growth of the former is depended up

EXAMINATION OF THE YELLOW DOCK (*Rumex crispus*).

This plant, which is regarded as a troublesome weed, has some valuable properties which make it worthy of a passing notice in this place. My assistant, Mr. SALISBURY, has given a very full account of its properties and composition in the American Journal of Agriculture and Science, which the reader may consult.

The plant, as usual, was divided into several parts; the leaves, seed, stem and root.

The organic composition of the leaves, when in their mature state, is as follows:

Starch	none.
Fibre with a little chlorophyl	1·755
Albumen	0·030
Casein	0·200
Dextrine	0·920
Bitter extract	3·570
Lignin containing ash 8·053	9·685
Dry matter	16·160
Water	83·680
	99·680 S.

The petioles contain nearly one per centum of free oxalic acid.

The ash of the leaves is composed of the following elements:

Carbonic acid	12·400
Silica	3·900
Earthy phosphates	24·000
Lime	1·633
Magnesia	0·880
Potash	10·613
Soda	22·880
Sodium	3·889
Chlorine	5·920
Sulphuric acid	1·477
Organic acid	8·500
	96·092 S.

The stalks gave the following result:

Carbonic acid	12·800
Silica	2·800
Earthy phosphates (containing phosphoric acid 14·747)	21·700
Lime	2·590
Magnesia	2·040
Potash	12·430
Soda	19·753
Sodium	3·368
Chlorine	5·085
Organic acids	9·200
	96·896 S.

Proportions of water, etc. in the stalk.

Water	83·800
Dry	16·200
Ash	1·480
Calculated dry	9·512

Proximate organic analysis of the root.

Starch	5·987
Albumen	1·431
Casein	0·226
Dextrine	2·024
Bitter extract (containing oxalic and tannic acids)	5·184
Fibre (containing ash 1·998)	14·228
Total of dry matter	29·080
Water	70·320
	99·400 S.

The ash was found to contain:

Carbonic acid	11·000
Silica	0·500
Earthy phosphates (containing 17·38 phosphoric acid)	26·200
Lime	3·827
Magnesia	7·620
Potash	9·723
Soda	18·480
Sulphuric acid	4·502
Chlorine	3·898
Organic matter	11·600

ANALYSIS OF THE ASH OF THE COFFEE BEAN, AND OF THE LEAVES OF GREEN TEA.

	Coffee.	Tea.
Silica	15·625	16·380
Earthy phosphates	33·700	42·912
Carbonate of lime	3·300	1·280
Magnesia	0·750	0·582
Potash	35·800	22·850
Soda	4·445	8·112
Sulphuric acid	5·650	5·275
Chlorine	none.	trace.
Organic matter	0·350	1·768
	99·580	98·159

PROPORTIONS.

	Coffee.	Tea.
Dry	800·00	250·000
Ash	25·88	12·125

Coffee and tea appear to be exhausting crops, both the bean and leaf being exported, and hence entirely lost to the soil upon which they grew.

CHAPTER VIII.

THE FRUIT AND FOREST TREES.

OF THE COMPOSITION OF THE ASH OF FRUIT AND FOREST TREES, WITH REMARKS ON THE DISTRIBUTION OF THE ELEMENTS IN THE PARTS AND ORGANS COMPOSING THEM.

THE fact ascertained by SAUSSURE, that plants require a certain amount of inorganic matter for the perfection of their foliage and seed, has made the subject of inquiries into the chemical constitution of vegetables extremely interesting and important. This fact increases in interest in consequence of another fact well ascertained, namely, that plants not only require a certain amount of matter usually denominated inorganic, but that this amount differs essentially with the different families, and even with the different species of plants. So it appears too that different parts and organs of the same plant require different amounts of the elements composing the ash. The seed and fruit, the root and trunk, the leaves and branches, each secure for themselves different quantities of what we may call the solid food. Even the seasons of the year are marked in the life of the vegetable by different proportions of inorganic matter. The vegetable system goes on accumulating inorganic matter slowly, until it has collected a store of food for future consumption.

I shall not attempt to post up what is known upon the subject before us; my object being to state generally the results of my investigations, and those which have been made by my assistant during the Survey. The analysis of the ash of forest and fruit trees has been prosecuted during a part of the last three years: more than a year of constant labor by myself and assistant has been thus bestowed. The analyses, it is proper to say, have not been made with the sole object of ascertaining the elements, or the proportion of elements, which enter into the constitution of plants; but a higher object has been in view, namely, the determination of the law of distribution of the elements. That a law should control their distribution appeared to be highly probable from analogy; and it may be inferred that the ends of existence are better subserved under its control, than if their distribution had been left to accident.

I now proceed to state that it was early conceived that the inorganic matter, in the growth of plants, was constantly determined by two movements: first, an upward movement, which really constitutes the circulation; and, secondly, an outward movement, by which the matters are transferred from the centre to the circumference, which movement results in a diminution of the inorganic „

carries outwards certain elements which are of greater importance than others. I allude here particularly to the phosphates, which, it is well known, are of primary importance in the fruit and seeds. The analyses have been conducted in part with reference to this supposed law of outward movement. The plan adopted, and which has been generally followed, was to divide the tree into the following parts : 1, the inside wood, or heart wood ; 2, the outside wood ; 3, the bark ; 4, the wood of the twigs ; 5, the bark of the twigs ; 6, the leaves ; 7, the seed, and the fruit with its envelopes. This plan of proceeding appeared to exhaust the subject, unless indeed we extend it so far as to inquire what changes take place in the amount of the elements in the different seasons. A few analyses have been made under this inquiry. The subject is of sufficient importance to merit a careful investigation.

The proper preparation of the ash is an operation that has been attended with some trouble. It is very liable to become caustic, or sub-caustic, and hence it happens that sufficient carbonic acid is never obtained to saturate the bases. This is not a matter of so much consequence as might at first appear : carbonic acid is not regarded as a constituent of the wood, but as a secondary product formed from the organic acid by ignition ; and the object in determining the amount of carbonic acid, is to test the accuracy of the analysis. The ash should be prepared at as low a temperature as possible, which shall at the same time secure a perfect combustion of the organic matter.

STATEMENT OF SOME RESULTS OF THE FOLLOWING ANALYSES.

I. It appears as a general result of the following analyses, that solubility controls in part the distribution of the inorganic matter of vegetables. Water never accumulates in the interior, or in the heart wood of a tree, but is carried upwards and outwards, and hence is found in a greater proportion in the leaves and in the outside wood. Being itself the great medium through which the solid matters are conveyed and distributed throughout the organs of vegetables, it is agreeable to what we might deduce *a priori* in regard to the distribution of the several proportional amounts of the inorganic matter. Moving as it is found to do, in a larger quantity to the periphery of the head and trunk, it must necessarily carry to the periphery a greater amount of solids than to the interior.

II. The distribution is not wholly controlled by the present movements of the water or sap which enters into the circulation of a tree. Some of the materials which form the wood of the interior is also absorbed and carried outwards to the periphery, or to the trunk. This statement is borne out by the results which have been so often obtained. The amount of ash of green and living wood is almost uniformly greater in the outside wood than in the heart wood. These two kinds of wood being weighed immediately after the tree is cut down, and equal portions of each taken, notwithstanding the water of the outside usually surpasses that of the inside, its ash exceeds that of the inside.

III. The bark of trees, as well as the outside covering of seeds, differs essentially in

constitution, as will be shown in the succeeding analyses, from the wood. In this part, the phosphates are deficient: although they are always present, still there is a great diminution in their amount, and to this statement an exception is not known. The bark, in its chemical constitution, is composed mainly of lime, probably an organic salt of lime, which by ignition is converted into a carbonate. There is also a great deficiency of potash and soda: they are equally small in amount with the phosphates. One or two curious facts, however, are observed in regard to the alkalies: it was found, for instance, that the outside and apparently lifeless part of the bark (the corky part of elm bark, for example) was richer in potash than the inside bark. This may be, and probably is, an isolated fact. It is well known to common observers that the elm is particularly rich in potash, which pervades all its parts and organs more generally than in other trees.

The final cause of the accumulation of lime in the bark, is to serve as an outward defence of the internal or young wood: it secures a firmer covering than can be provided by the other elements. In this respect there is a very close analogy with the formation of the outer covering of the lower animals, which, as is well known, consists mainly of carbonate of lime, as in the crustacea and annulose animals. As in the animal tissues, outward defences are set up, so in the vegetable they are not left wanting. Here too a provision is furnished, by which this great amount of lime is returned to the soil. The bark is annually detached, and its store of soluble or partially soluble salts of lime is rapidly returned to the soil. An aged oak may have regenerated its bark repeatedly from its own debris: its outward covering, which is partially renewed every year, may derive a portion of its supply from what previously formed part of its own organism.

Upon this general fact is founded the law of distribution, the inorganic matters respectively being determined to the periphery of the head and trunk. The few exceptions which have been found, and which militate against this law, can hardly be regarded as sufficiently numerous and important to overthrow it.

Of the substances which appear to be more steadily and uniformly determined to the outside wood, I may state the following, leaving out of the account water, which acts as the medium through which every thing is conveyed into and throughout the tree.

The phosphates abound more in the periphery than in the centre: they are found also in larger quantities in the young wood of the twigs; therefore both the outside of the tree, and its growing branches, store up for the time being a larger amount of these essential elements than the interior. It is by this mode of distribution that the seeds and fruit receive their needful supply of phosphates: at least the supply is derived more immediately and directly, than if the contrary mode of distribution prevailed.

The final cause of this distribution of the phosphates, is to restore again to the soil those important elements. They pass along the outside wood of the trunk, obtaining probably an accession from the interior by the outward or lateral movement of the sap: they then pass to the seed and fruit, through the small branches, twigs and leaves. All the surplus amount of the phosphates in the leaves is restored to the earth by their fall and decay; and, besides, in a multitude of instances, the seed and fruit also return by their maceration

and decay, or in consequence of their constituting the food of animals. The phosphates, in this case, after performing their several offices in the system of animals, return to the soil from whence they were originally derived.

Another explanation, which may appear more plausible, is, that after a certain period in the life of the oak, or any tree, a greater amount of inorganic matter may accumulate, than at any previous period, in consequence of the spreading of the roots, and the subsequent increased supply of this kind of nutriment from the original sources. In its full maturity and strength, it takes up from the soil a greater amount of inorganic matter, which it is then more capable of assimilating or converting into wood.

The quantity, however, of inorganic matter may vary with the season. There may be an accumulation of the phosphates and some other substances in autumn, which is designed to go on slowly during the winter, by which a sufficiency of these elements is secured for the immediate use of the tree in the spring when the leaves are about to be developed. This undoubtedly would take place in the periphery mainly, or newer wood. From some of the analyses which were made of winter cut wood, there appears a larger amount of phosphates in the wood than in that which was cut after the leaves were fully formed.

Whatever view we may adopt, it is evident that the analysis of the ash, taken without reference to the organ or part, does not determine all we wish to know of the chemistry of vegetation. The truth of this remark is sustained by all the analyses of the organs of plants, as leaves, fruit and seed; and I have no doubt it is equally true of the parts of the trunk, the heart and alburnum, and the smaller branches.

PROPORTIONS AND ANALYSES OF THE ASH OF FOREST AND FRUIT TREES.

1. PROPORTIONS OF THE PROXIMATE ELEMENTS.

I. SOFT WOODS, OR CONIFEROUS TREES.

1. White Pine (Ash of seasoned bark).

Water	6·10
Dry bark	93·90
Ash	0·22

2. Yellow Pine (*Pinus rigida*).

	Sap wood.	Bark of twigs.	Heart wood.	Leaves.	Small limbs.
Water	37·00	40·32	22·50	54·55	47·00
Dry wood	63·00	50·68	77·50	45·45	53·00
Ash	0·15	0·64	0·15	0·50	0·25

3. Red Cedar (*Juniperus virginiana*).

	Sap wood.	Heart wood.	Bark.*
Water	41·94	17·50	20·90
Dry wood	58·06	82·50	79·10
Ash	0·15	0·04	
Organic matter	57·91	82·46	8·42

4. Hemlock (*Abies canadensis*), seasoned.

Water	18·00
Dry wood	82·00
Ash	0·61

II. THE HARD WOODS.

1. White Oak (*Quercus alba*).

	Sap wood.	Heart wood.	Bark of the trunk.	Bark of twigs.	Small limbs.
Water	35·440	30·900	27·71	40·30	35·000
Dry	64·460	69·100	72·29	59·70	65·000
Ash	0·640	0·180	11·30	4·72	0·550
Organic matter,	63·920	68·920	69·39	54·98	64·450
Calculated dry,	0·991	0·261	15·63	7·90	0·846

2. Black Walnut (*Juglans nigra*).

	Sap wood.	Heart wood.	Bark of the trunk.	Bark of the twigs.	Wood of the twigs.
Water	38·900	45·050	48·75	49·260	39·65
Dry	61·100	54·950	51·25	50·800	60·35
Ash	0·540	0·360	3·99	3·715	1·20
Organic matter,	59·936	47·285			
Calculated dry,	0·950	0·919			

Tap root of the young tree.

	Wood of the root.	Bark of the root.
Water	56·17	58·60
Dry	43·83	41·40
Ash	0·85	1·10

3. Common Butternut (*Juglans cinerea*). Branch one inch in diameter.

	Wood.	Bark.
Water	38·50	40·00
Dry	61·50	60·00
Ash	0·37	2·80

* Seasoned stick 32 years old.

4. Beech wood (*Fagus sylvestris*).

	Sap wood.	Heart wood.	Wood of twigs.	Bark of twigs.
Water - - - -	40·45		37·40	35·61
Dry - - - -	59·55		62·50	64·39
Ash - - - -	0·85	0·26	0·47	5·53

The percentage of charcoal in beech wood amounts to 17·16. Deducting 0·85 for inorganic matter, it leaves 16·94 from which all volatile matter has been expelled by ignition in a close vessel.

5. Iron-wood (*Ostrya virginica*).

	Sap wood.	Heart wood	Wood of twigs.	Bark of twigs.
Water - - - -	30·00	36·96	21·45	23·83
Dry - - - -	65·00	63·04	78·55	76·17
Ash - - - -	0·196	0·301	0·64	9·321
Organic matter - -	64·805	62·739	77·91	69·07
Calculated dry - -	0·300	0·475	0·815	9·321

The iron-wood, when ignited in a close vessel, gives 16·21 per centum of charcoal, or matter free from volatile substances : deducting 0·30 for inorganic matter, it leaves 15·91 as pure charcoal.

Seasoned wood of the Ostrya virginica, *or Iron-wood.*

	Heart wood.	Sap wood.	Bark.
Water - - - - - -	14·80	19·06	14·30
Dry - - - - - -	85·20	80·94	85·70
Ash - - - - - -	0·40	0·28	8·06
Organic matter - - - -	84·80	80·66	77·64
Calculated dry - - - -	0·467	0·344	9·406

The Iron-wood is one of the instances in which the percentage of ash is greater in the heart wood than in the sap wood. The tree, as is well known, grows slowly, and never attains a large size ; and the one from which the wood was taken for experiment, was about eight inches in diameter. The seasoned wood was from a small tree about the same size as the preceding, but was one hundred years old.

6. Broad-leaved Laurel (*Kalmia latifolia*).

	Wood of the trunk.	Wood of the root.	Bark of trunk.	Leaves.
Water - - - -	30·30	36·30	18·73	49·19
Dry - - - -	70·00	63·70	81·27	50·81
Ash - - - -	0·22	0·10	0·70	1·46

The percentage of charcoal of this very compact wood amounts to only 7·30 ; and deducting the inorganic matter, 6·60 is pure charcoal.

7. Horse Chestnut (*Æsculus hippocastanum*).

	Sap wood near the bark.	Sap wood near the heart.	Heart wood.	Wood of limbs.	Bark of limbs.	Outside bark of the trunk.	Inside bark of the trunk.
Water.	50·00	47.50	58·05	23·70	36·25	17·35	44·35
Dry -	50·00	52·50	41·95	76·30	63·75	83·65	55·65
Ash -	0·35	0·62	1·50	1·15	3·50	10·00	5·00

Limbs of the Æsculus hippocastanum (*same tree*), *at different stages.*

1. April 26. Limbs taken about two inches in diameter. Buds just bursting.

	Bark.	Wood.
Water - - - - - -	51·00	56·13
Dry matter - - - - -	49·00	43·87
Ash - - - - - -	5·00	0·51
Ash calculated on the dry matter -	10·204	1·162 S.

2. May 29. Limbs about two inches in diameter. Flowers just fallen.

	Wood.	Bark.
Water - - - - - -	48·03	53·50
Dry matter - - - - -	51·97	46·50
Ash - - - - - -	0·58	4·29
Ash calculated on the dry matter -	1·116	9·226 S.

The two following analyses exhibit a difference in the amount of ash and dry matter in the leaves of two Horse Chestnut trees growing on the same soil, and subjected as nearly as they could well be to the same conditions. There was also much difference in the appearance of the bark, flowers, and shape of the leaves in the two trees. The leaves were gathered May 18th, when the trees were in full bloom; and the middle leaflet of equally vigorous leaves from each tree was selected for analysis.

No. 1. The middle leaflet weighed 57·5 grains, and gave

	Actual quantities	Per centum.
Water - - - - - -	41·19	71·633
Dry matter - - - - -	16·31	28·367
Ash - - - - - - -	1·33	2·313
Ash calculated on the dry matter -		8·157 S.

No. 2. The middle leaflet weighed 77·25 grains, and gave

	Actual quantities	Per centum.
Water - - - - - -	55·40	71·715
Dry matter - - - - -	21·75	28·285
Ash - - - - - - -	1·58	2·045
Ash calculated on the dry matter -		7·264 S.

The leaves of No. 2 are much larger (the leaflets being wider and longer) than those of No. 1.

8. White Elm (*Ulmus americana*).

	Sap wood.	Heart wood.	Outside bark of trunk.	Inside ditto.	Bark of limbs.	Wood of limbs.
Water -	34·65	49·50	19·00	47·50	42·60	36·50
Dry -	65·35	50·50	81·00	52·50	57·40	63·50
Ash -	0·80	0·35	8·25	7·25	7·50	0·45

The elm gave, on ignition in a close vessel, 15·84 per centum of charcoal, or matter free from volatile elements: subtracting the inorganic matter, it leaves 15·04 per centum of pure charcoal. The outside bark of this elm consists of alternate layers of common ligneous matter and cork, which, though thin, is fine and elastic.

9. Chestnut (*Castanea vesca*).

	Wood of the trunk.
Water - - - - - - - -	42·35
Dry - - - - - - - -	57·65
Ash - - - - - - - -	0·48

The percentage of charcoal in this wood amounts to 9·75 only: ash being deducted, it leaves 9·27.

10. White Maple (*Acer dasycarpum*).

	Sap wood.	Heart wood.	Bark of the trunk.	Bark of limbs.	Wood of limbs.
Water - -	35·50	37·50	40·00	41·45	31·00
Dry - - -	74·50	62·50	60·00	58·45	69·00
Ash - - -	0·25	0·20	3·25	2·75	0·35

11. Willow. Trunk ten inches in diameter.

	Sap wood.	Heart wood.	Bark of the trunk.
Water - - - - -	59·55	37·45	41·10
Dry - - - - - -	40·65	62·55	58·90
Ash - - - - - -	0·28	0·25	6·26

12. Grape vine (*Vitis labrusca*).

	Wood.
Water - - - - - - -	40·26
Dry - - - - - - -	59·74
Ash - - - - - - -	0·98

13. Black Ash. Seasoned wood.

	Sap wood.	Bark.
Ash - - - - - - -	0·34	8·19

14. Bass-wood (*Tilia americana*).

	Sap wood.	Bark.
Water	51·30	46·32
Dry	48·70	53·68
Ash	0·28	3·57

15. Black Birch (*Betula excelsa*).

	Sap wood.	Heart wood.
Water	38·90	34·61
Dry	61·10	65·39
Ash	0·05	0·26

The black birch gives 16·01 per centum of charcoal : deducting the inorganic matter, it leaves 15·96 per centum from which all volatile matter is expelled by ignition in close vessels.

16. Staff-tree (*Cerastrus scandens*).

	Bark.	Wood.
Water	39·091	46·094
Dry matter	60·909	53.906
Ash	4·608	0·523
Ash calculated on the dry matter	7·582	0·971 S.

III. FRUIT TREES.

1. Pear tree.

	Sap wood.	Heart wood.	Bark of the trunk.
Water	48·80	22·05	63·70
Dry	37·20	77·95	30·30
Ash	0·20	0·10	1·99

Root of the Pear tree.

	Wood.	Bark.
Water	22·33	58·80
Dry	79·67	46·20
Ash	0·40	3·26

The wood of the pear gives 9·79 per centum of charcoal. The wood of the pear is soft, close grained and easily wrought, and hence is sometimes substituted for box in large wood engravings.

2. Sweet Apple tree.

	Sap wood.	Heart wood.	Bark of the trunk.
Water	39·10	33·35	59·00
Dry	60·90	66·65	41·00
Ash	0·35	0·16	4·55

3. Sour Apple tree.

	Sap wood.	Heart wood.	Bark of the limbs.
Water	39·13	46·30	45·10
Dry	60·87	53·70	54·90
Ash	0·25	0·20	3·33

The apple-tree wood gives a heavy compact coal amounting to 15·90 per centum, or 15·70 abstracting the ash.

4. Small Red Cherry. Seasoned.

	Wood.
Water	10·00
Dry	90·00
Ash	0·17

5. Peach tree. The leaves (August 7).

	Leaves.	Leaves just formed.
Water	67·00	
Dry	33·10	23·93
Ash	4·62	

Bark of the twigs (May 10).

Water	60·8
Dry	39·4
Ash	5·66

Healthy Peach leaves, from New-Jersey.

Water	69·00
Dry	31·00
Ash	1·75

Peach leaves diseased with the yellows.

Water	64·00
Dry	36·00
Ash	1·82

Healthy Peach leaves (Malacotoon), from New-Jersey.

Water	63·10
Dry	36·90
Ash	3·00

Leaves diseased with the yellows.

Water	54·46
Dry	45·54
Ash	3·87

6. *Leaves of the* CATAWBA GRAPE, picked June 2. Full size.

Water - - - - - - - -	72·388
Dry matter - - - - - - - -	27·612
Ash - - - - - - - -	2·138
Ash calculated on the dry matter - - -	7·746 S.

7. *Leaves and petioles of the* VIRGALIEU PEAR-TREE, picked May 23. Flowers just fallen.

Water - - - - - - - - -	73·082
Dry matter - - - - - - - -	26·918
Ash - - - - - - - - -	1·299
Ash calculated on the dry matter - - -	4·213 S.

8. *Leaves and petioles of the* OX-HEART CHERRY, picked May 23. Flowers just fallen.

Water - - - - - - - - -	74·429
Dry matter - - - - - - - -	25·571
Ash - - - - - - - - -	1·569
Ash calculated on the dry matter - - -	6·135 S.

9. *Leaves and petioles of the* LADY APPLE, picked May 23. Flowers just fallen.

Water - - - - - - - - -	70·261
Dry matter - - - - - - - -	29·739
Ash - - - - - - - - -	1·412
Ash calculated on the dry matter - - -	4·747 S.

The following proportions of water, dry wood and ash, were determined by my assistant Mr. SALISBURY. The specimens of the trees were obtained in May.

TABLE I.

	The Rose.		Xanthoxylum americau.		Laurus sassafras.		Populus tremuloides.	
	Wood.	Bark.	Wood.	Bark.	Wood.	Bark.	Wood.	Bark.
Percentage water,	32·67	36·92	24·00	22·05	30·38	46·26	40·52	50·70
Percentage dry -	67.33	63·08	76·00	77·95	69·62	53·74	59·48	49·30
Percentage ash -	0·33	2·41	0·49	7·88	0.38	2·17	0·33	3·95

TABLE II.

	Rhus typhina.			Wild Plum.		Cornus alternifolia.	
	Bark.	Sap wood.	Heartwood	Wood.	Bark.	Wood.	Bark.
Percentage water,	35·74	25·24	21·06	18·80	26·08	34.03	54·15
Percentage dry -	64·26	74·76	78·94	81·20	63·92	65.97	45·85
Percentage ash -	2·89	0·28	0·43	0·37	6·05	0·20	2·41

II. ANALYSES OF THE ASH.

I. FOREST TREES.

1. Hemlock (*Pinus canadensis*).

Tree sound. Diameter five feet from the base, 25 inches. Average thickness of the bark about one inch. Half of the diameter was produced during the last fifty years growth : these 50 outside layers were taken for outside wood; and the remaining layers, 154 in number, for inside wood. Whole number of layers five feet from the ground, 204: average thickness of each layer, 0·05637 of an inch.

	Bark.	Outside wood.	Inside wood.	Bark of twigs.	Wood of twigs.
Potash	2·86	19·23	1·64	1·575	0·506
Soda	3·47	8·46	0·54	1·333	5·31
Chloride of sodium	0·03	0·10	0·03	0·994	0·42
Sulphuric acid	3·48	3·03	11·96	4·47	3·213
Carbonic acid	24·33	7·81	7·63	24·00	28·88
Lime	31·48	10·11	9·88	31·05	25·20
Magnesia	0·01	2·48	3·24	0·30	2·88
Phosphate of peroxide of iron,	1·49	2·72	0·29	1·55	
Phosphate of lime	16·45	16·66	11·38	18·87	20·40
Phosphate of magnesia	5·17	9·89	26·45	1·28	
Organic matter	3·48	1·71	2·40	4·10	0·212
Insoluble silica	13·40	5·28	1·05	0·40	0·70
Coal	1·22	1·24	0·82	0·48	1·51
	106·87 S.	88·72 S.	77·31 S.	90·402	89·231

2. Sugar Maple (*Acer saccharinum*).

Tree sound. Diameter three feet from the ground, 28 inches; do. twelve feet from the ground, 21½ inches. From the base to the limbs, 62 feet. Whole length of the tree, 107 feet. Average thickness of the bark, ⅜ inch. Age 224 years. At twelve feet from the base, the 100 outside layers were taken for outside wood, making a thickness of 4⅝ inches; the remaining layers were taken for inside wood. Growth very uniform. Average thickness of each layer, 0·04464 of an inch.

	Bark.	Outside wood.	Heart wood.
Potash	0·88	8·77	4·21
Soda	7·75	0·964	
Chloride of sodium	0·08		0·08
Sulphuric acid	1·497	1·171	1·03
Carbonic acid	37·12	37·247	33·33
Lime	49·33	31·86	43·14
Magnesia	3·64	8·40	7·24
Phosphate of peroxide of iron	0·32	0·70	1·34
Phosphate of lime	3·13	5·70	5.09
Phosphate of magnesia	0·02	1·80	0·22
Organic matter	1·50	2·40	1·93
Insoluble silica	0·15	0·50	0·55
	105·417 S.	100·512	98·16 S.

3. CHESTNUT (*Castanea vesca*).

	Bark.	Outside wood.	Inside wood.
Potash	1·36	4·56	2·73
Soda	0·319	1·41	1·98
Chloride of sodium	trace.		
Sulphuric acid	0·312	0·50	
Carbonic acid	39·90	23·842	29·52
Lime	51·60	40·76	38·20
Magnesia	0·60	5·77	0·513
Phosphate of peroxide of iron	0·20	1·30	0·30
Phosphate of lime	2·90	17·44	8·60
Phosphate of magnesia			
Organic matter	5·00	1·74	3·20
Silica	1·20	1·43	1·71
Coal	1·00	0·914	1·76
Moisture	3·00		2·13
	107·391	99·666	90·143

4. HORSE CHESTNUT (*Æsculus hippocastanum.*)

Tree in full bloom May 26, at which time the young sprouts (of about five weeks growth), petioles, leaves, peduncles and flowers were gathered for analysis; but the root analyzed was cut from its tree in April.

	Bark of root.	Wood of root.	Bark of sprouts.	Wood of sprouts.	Petioles.	Leaf-blades.	Peduncles and flowers.
Potash	10·88	16·83	17·97	26·33	30·95	7·58	30·71
Soda	15·71	3·27					
Chloride sodium,	0·76	0·36	2·27	4·47	4·12		
Sulphuric acid,	7·32	6·39	26·45	28·46	30·93	21·94	30·55
Carbonic acid.	8·47		5·71	0·04	2·27	18·29	0·13
Lime	36·83	5·19	7·39	0·06	2·93	2·91	0·17
Magnesia	0·90	5·30	0·25	0·05	0·10	3·00	0·01
Phos. perox. iron,	1·40	1·10	0·30	0·30	0·20	2·50	4·20
Phos. lime,	10·15	45·64	15·90	22·70	17·95	31·75	25·65
Phos. magnesia,	0·25	0·01	0·50	0·02	0·75	0·75	3·75
Organic matter,	5·60	3·60	22·46	17.09	9.60	6·24	3·20
Insoluble silica,	2·00	3·30	0·80	0·50	0·20	5·50	2·00
Coal	0·80	11·00					
	101·07 S.	101·99 S.	100·00 S.	100·00 S.	100·00 S.	100·46 S.	100·37 S.
PROPORTIONS.							
Per cent. water,	57·95	50·14	82·90	88·10	87·94	74·80	85·24
Per cent. dry,	42·05	49·86	17·10	11·90	12·06	25·20	14·76
Per cent. ash,	3.88 S.	1·04 S.	1·63 S.	1·15 S.	1·56 S.	1·68 S.	1·83 S.

5. Swamp White Oak (*Quercus bicolor*).

	Bark.	Outside wood.	Inside wood.
Potash	0·459	20·49	14·79
Soda	trace.	3·15	3·69
Chloride of sodium			
Sulphuric acid	0·295		
Carbonic acid	40·335	32·919	34·61
Lime	52·26	30·23	35·87
Magnesia	0·25	0·50	0·51
Phosphates	3·50	5·20	6·30
Organic matter	2·13		2·70
Silica	2·00	1·50	0·50
Coal	2·50	4·00	1·60
Moisture			2·60
	103·729	97·999	103·17

6. White Oak (*Quercus alba*).

Ash obtained from the green wood.

	Sap wood.	Heart wood.	Wood of twigs.	Bark of trunk.	Bark of twigs
Potash	13·41	9·68	9·74	0·25	1·27
Soda	0·52	5·03	6·89	2·57	4·05
Sodium	2·78	0·39	0·16	0·08	0·08
Chlorine	4·24	0·47	0·25	0·12	0·13
Sulphuric acid	0·12	0·26	0·08	0·03	trace.
Phosphate of peroxide of iron, Phosphate of lime, Phosphate of magnesia	32·25	13·30	23·60	0·60 10·10	14·15
Carbonic acid	8·95	19·29	17·55	29·80	30·33
Lime	30·85	43·21	34·10	54·89	47·72
Magnesia	0·36	0·25	0·50	0·20	0·20
Silica	0·21	0·88	0·55	0·25	0·65
Soluble silica	0·80	0·30	0·60	0·25	0·65
Organic matter	5·70	7·10	5·90	1·16	1·52
	100·18 S.	100·06 S.	99·99 S.	100·05 S.	100·00 S.

The oak grew in the immediate neighborhood of Albany, upon a stiff clay known as the Albany clay.

7. White Elm (*Ulmus americana*).

Tree sound. Diameter three feet from the base, 28 inches; ditto fourteen feet from the base, 25½ inches. **Mean thickness** of the bark, ¾ inch. Whole length of the tree, 111 feet. Number of layers fourteen feet from the base, 208. Average thickness of each layer, 0·05769 of an inch. Thickness of layers quite uniform. From 80 to 85 outside layers taken for outside wood; the remaining layers, for inside wood.

First Specimen.

	Bark of trunk.	Outside wood.	Bark of twigs.	Wood of twigs.
Potash	3·79		5·82	9·61
Soda	1·65		6·53	18·41
Chloride of sodium	trace.		0·07	
Sulphuric acid	0·14	12·02	2·80	3·98
Carbonic acid	39·44		24·72	26·07
Lime	27·46		16·92	14·77
Magnesia	13·10		3·00	2·40
Phosphate of peroxide of iron, Phosphate of lime, Phosphate of magnesia	3·40		24·50	22·35
Organic matter	2·00		1·50	
Insoluble silica	1·75			0·50
Coal				0·30
Moisture	3·10			
	95·86	12·02	95·82	97·49

Second Specimen.

	Sap wood.	Heart wood.	Outside bark.	Inside bark.
Potash	15·85	8·64	5·32	1·17
Soda	7·64	20·49	3·22	2·17
Chlorine	0·74	0·09	1·21	0·05
Sulphuric acid	0·12	0·14	0·10	0·04
Phosphate of peroxide of iron, Phosphate of lime, Phosphate of magnesia	14·53	2·75	19·55	3·775
Carbonic acid	29·51	28·225	13·26	42·515
Lime	20·08	22·635	30·26	42·495
Magnesia	4·72	10·08	4·84	8·16
Silica	2·00	3·25	12·15	1·25
Soluble silica			1·60	
Organic matter	1·45	1·80	4·12	0·40
	98·46 S.	99·115 S.	99·69 S.	102·025 S.

8. Red Elm (*Ulmus fulva*).

Tree sound. Average diameter four feet from the base, 20 inches. Average thickness of bark, $\frac{3}{8}$ inch. Average thickness of each layer, 0·0564 of an inch. Between 20 and 25 layers were taken for outside wood, thickness $2\frac{1}{4}$ to 3 inches; the remaining layers were taken for inside wood. Growth quite uniform.

	Bark.	Outside wood.	Heart wood.	Bark of twigs.	Wood of twigs.
Potash	0·11	13·43	7·34	3·79	5·82
Soda		16·96	7·89	7·87	19·74
Chloride of sodium		0·05	0·05	trace.	0·20
Chloride of potassium	0·06				
Sulphuric acid	5·36	0·81	4·57	5·79	8·94
Carbonic acid	34·41	16·96	26·89	33·12	12·69
Lime	44·64	31·00	34·79	32·12	17·72
Magnesia	3·09	5·24	2·20	1·68	4·80
Phosphate of peroxide of iron,	0·04	0·65	1·35	0·20	0·40
Phosphate of lime	6·36	12·97	11·28	6·00	25.80
Phosphate of magnesia		2·93	2·18		0·20
Organic matter	2·10	1·93	1·60		10·84
Silica	2·81	1·31	0·55	6·50	0·40
Coal				3·50	
	98·98 S.	104·24 S.	100·69 S.	100·57	107·45 S.

9. Cork Elm (*Ulmus racemosa*).

	Wood.	Bark.
Potash	25·93	8·884
Soda	1·70	0·498
Chlorine	0·30	0·560
Sulphuric acid	2·57	4·485
Phosphate of peroxide of iron		
Phosphate of lime	13·77	5·605
Phosphate of magnesia		
Carbonic acid	17·70	19·568
Lime	22·83	46·912
Magnesia	8·20	1·557
Silica	3·57	11·214
Soluble silica	1·67	1·121
Organic matter	not determined.	
	98·24 S.	99·807 S.

The structure of this wood is singular and beautiful, and is probably readily distinguished from any other wood by a transverse section (See Pl. viii. fig. 2). In this figure, the

wavy light bands mark the direction of the pores through which the sap ascends, and the circular zone of pores shows the commencement of a new annual layer. The last are always formed in the spring, when the first growth of wood begins; the former belong to successive periods during its summer growth. The Elm, together with the allied genus, the *Celtis*, exhibits this peculiar wavy arrangement of its summer pores. There are variations, in the different species, in the arrangement of these pores; yet the plan, as a whole, is the same.

For magnificent specimens of the Elm, the vallies of the Genesee, and the Black river in Jefferson county, are surpassed by no other parts of the world. Hundreds of elms may be seen in either of these sections of country, exceeding by far the famous Pittsfield Elm in Berkshire, Mass. The elms of the Mohawk valley belong generally to the pendulous variety, and do not excel in size, but many may be seen profusely decked with slender branches, and give great beauty to the landscape. This variety is figured in the first volume of Agriculture, Pl. ii. The elm has been sacrificed in all parts of the State, during its first settlement, for the sake of its ash. It furnishes not only a large percentage, but it is also rich in alkalies.

The elm is a favorite on both continents. It is highly ornamental, and the wood is useful for many purposes. Like domesticated animals, it seems to have been designed for man in his more civilized state; and, like them too, it breaks out into numerous varieties, in some of which we have the majestic trunk adorned with a towering, upright or spreading head; or a trunk profusely decked with slender limbs, as if covered with twining ivy, and a head profuse in long pendant and waving plumes.

In some parts of New-York, especially where meadows skirt a sluggish stream, the White Elm stands unrivalled in height and girth. Its hundred feet to a branch, a girth numbering a score feet or more, mark but a common size. The rich alluvial bottoms are best adapted to the wants of this tree: it there finds an abundance of food and water; and as it continues to grow for centuries, it here attains its maximum strength and size, and well deserves the name of the forest monarch. For transplanting, it is recommended by its easy culture and rapid growth, and its ability to adapt itself to any soil or location.

The Elm has a wide range of growth. The Saskatchawan, or in Canada at 48° 20′ north, to Georgia south, constitute its extreme limits, and so it extends itself from the Atlantic far west. The north and south boundaries of New-York embrace probably the most favorable zone for this tree.

The wood of the elm rarely if ever splits very free; its fibres being too much twisted or interwove with each other, to admit of an easy separation. In consequence, however, of this very fault, it is better adapted to planks for stabling, for ox yokes, and all purposes where lightness and strength are required, and where an easy separation of its fibres would be a damage, as wagon hubs, and large ship blocks.

10. Hickory (*Carya alba*).

The wood had been seasoned during one summer and fall, and grew in the valley of the Mohawk.

	Outside sap wood.	Inside sap wood.	Heart wood.	Bark.
Potash	7·472	20·187	12·210	2·340
Soda	0·084	0·085	0·055	0·125
Chlorine	0·096	0·085	0·065	0·145
Sulphuric acid	0·892	4·640	5·260	1·925
Phosphate of peroxide of iron, Phosphate of lime, Phosphate of magnesia	14·440	11·450	6·340	5·000
Carbonic acid	29·576	21·405	33·630	33·995
Lime	38·264	27·695	43·520	51·105
Magnesia	6·200	8·600	4·000	0·820
Silica	4·200	6·150	1·300	4·550
Soluble silica	0·280	0·010	trace.	0·250
Organic matter	undetermined.			
	101·504 S.	100·331 S.	106·390 S.	100·255 S.

11. Iron wood (*Ostrya virginica*).

	Sap wood.	Heart wood.	Wood of twigs.	Bark of trunk.	Bark of twigs.
Potash	1·581	14·549	20·76	0·696	2·78
Soda	0·025	0·086	2·97	0·023	0·405
Chlorine	0·049	0·098	0·25	0·04	0·15
Sulphuric acid	0·086	0·378	0·64	0·086	0·52
Phosphate of peroxide of iron, Phosphate of lime, Phosphate of magnesia	5·65	23·10	35·4	5·10	10·55
Carbonic acid	36·159	20·139	12·22	33·853	33·975
Lime	48·791	27·461	20·98	57·932	48·225
Magnesia	4·20	4·40	5·6	1·20	1·00
Silica	0·20	0·40	0·4	0·25	2·30
Soluble silica				0·276	
Organic matter	2·853	undetermined.			
	99·577 S.	90·611 S.	99·21 S.	99·456 S.	99·905 S.

12. Black Birch (*Betula lenta*).

Tree slightly hollow at the base. Diameter eight feet from the base, 17½ inches. Mean thickness of the bark, ½ inch. Number of layers eight feet from the base, 235. Average thickness of each layer, 0·03564 of an inch. Growth quite uniform. From 80 to 85 of the outside layers were taken for outside wood: thickness 3¼ inches.

	Bark.	Outside wood.	Heart wood.
Potash	2·59	7·34	8·25
Soda	1·87	12·93	10·30
Chloride of sodium		0·10	0·12
Sulphuric acid	9·537	2·61	4·12
Carbonic acid	37·156	24·06	26·44
Lime	41·446	31·14	34·86
Magnesia	2·32	8·0	2·64
Phosphate of peroxide of iron	0·20	1·4	1·40
Phosphate of lime	10·20	16·4	19·89
Phosphate of magnesia	none.	0·6	0·51
Organic matter	0·44	3·2	4·39
Insoluble silica	0·40	1·6	1·90
Coal	0·30		
	106·459	109·68 S.	114·82 S.

13. Yellow Birch (*Betula excelsa*).

Tree sound. Diameter four feet from the base, 21½ inches. Average thickness of the bark, ½ inch. Number of layers four feet from the base, 184. Average thickness of each layer, 0·0557 of an inch.

	Bark.	Outside wood.	Heart wood.
Potash	0·917	4·237	5·60
Soda	0·543	12·36	9·54
Chloride of sodium	2·369	0·12	
Sulphuric acid	3·021	6·87	1·92
Carbonic acid	33·25	18·857	36·69
Lime	48·22	27·50	22·33
Magnesia	2·40	8·96	9·76
Phosphate of peroxide of iron,		2·30	1·41
Phosphate of lime	9·70	18·50	15·35
Phosphate of magnesia			
Organic matter	1·50	5·00	0·80
Insoluble silica		1·60	0·90
Coal		1·00	0·30
	101·94	107·304	104·60

14. Bass-wood (*Tilia americana*).

Tree sound. Mean diameter four feet from the ground, 22 inches. Average thickness of the bark, 1 inch. Age 182 years. About 60 of the outside layers were taken for outside wood, thickness 4½ inches; the remaining layers taken for inside wood. Growth uniform. Average thickness of each layer, 0·0549 of an inch.

	Bark.	Outside wood.	Heart wood.	Bark of twigs.	Wood of twigs.
Potash	1·26	10·12	4·05	1·90	14·55
Soda	12·77	2·88	10·41	9·14	
Chloride of sodium	0·24	0·50	0·52	0·15	0·10
Sulphuric acid	0·72	0·88	0·27	4·19	13·34
Carbonic acid	25·38	16·64	17·96	22·84	3·94
Lime	41·92	38·36	45·24	29·56	11·56
Magnesia	2·24	7·36	7·44	3·00	7·44
Phosphate of peroxide of iron,	0·20	1·20	1·30	0·31	0·60
Phosphate of lime	8·50	17·95	8·96	24·77	38·92
Phosphate of magnesia	0·30	2·60	0·04	0·72	1·28
Organic matter	1·70	2·53	2·00	2·40	9·61
Insoluble silica	4·60	2·10	1·40	0·40	0·10
Coal				0·80	
	99·83 S.	103·12 S.	99·59 S.	100·18 S.	101·44 S.

15. Butternut (*Juglans cinerea*).

Tree sound. Diameter three feet from the ground, 2 feet 8 inches; eleven feet from the ground, 1 foot 8 inches. The section for analysis was taken eleven feet from the ground. Average thickness of the bark, ¾ inch. Age 146 years. Between 65 and 70 outside layers were taken for outside wood, thickness 4½ inches; the remaining inside layers taken for inside wood. Growth of tree more rapid when young.

	Bark.	Outside wood.	Heart wood.	Bark of twigs.	Wood of twigs.
Potash	1·00	4·42	1·00	0·63	3·28
Soda	11·27	5·61	14·82	11·24	14·59
Chloride of sodium	0·15	0·16	0·13	0·03	0·03
Sulphuric acid	0·74	13·33	21·43	5·33	5·36
Carbonic acid	32·12	20·02	4·48	18·92	7·02
Lime	37·68	38·98	42·02	24·48	9·08
Magnesia	10·08	3·52	4·00	2·22	5·34
Phosphate of peroxide of iron,	0·30	3·40	3·41	0·41	0·50
Phosphate of lime	2·25	2·20	0·59	29·25	40·39
Phosphate of magnesia	0·15	0·06	0·28	1·04	1·61
Organic matter	2·80	3·40	3·20	4·41	5·20
Insoluble silica	0·30	4·80	5·40	0·40.	0·32
Coal				0·80	1·21
Water					3·41
	98·84 S.	100·20 S.	100·76 S.	99·16 S.	97·34 S.

16. Red Beech (*Fagus ferruginea*).

Tree a little hollow at the base. Diameter three feet from the ground, 28 inches; fourteen feet from the ground, 22 inches, sound. Average thickness of the bark, $\frac{1}{4}$ inch. Section for analysis taken fourteen feet from the ground. Age 240 years. Growth quite uniform. Average thickness of each layer, 0·0453 of an inch. Between 60 and 65 outside layers taken for outside wood; the remaining layers for inside wood.

	Bark.	Outside wood.	Heart wood.	Bark of twigs.	Wood of twigs.
Potash	0·13	12·13	4·04	0·63	11·00
Soda		15·58	25·53	4·63	11·79
Chloride of sodium		0·05	0·24	0·14	0·16
Sulphuric acid		0·47	0·62	4·54	14·68
Carbonic acid	40·41	24·39	24·59	18·18	1·79
Lime	52·29	31·56	31·82	23·52	2·31
Magnesia	0·32	5·44	1·44	3·41	6·08
Phosphate of peroxide of iron,	1·96	0·85	0·40	0·41	0·80
Phosphate of lime		17·23	22·04	18.89	35·60
Phosphate of magnesia		0·93	0·02	0·10	10·89
Organic matter		1·86	2·80	3·01	10·50
Insoluble silica	3·30	1·45	1·60	29·00	0·92
Coal	1·50				0·31
	99·91 S.	111·99 S.	115·14 S.	106·46 S.	106·83 S.

17. Black Cherry (*Cerasus serotina*).

Tree sound. Diameter three feet from the ground, 36 inches; twelve feet from the ground, 30$\frac{1}{2}$ inches; seventy-two feet from the ground, 24 inches. From base to limbs, 72 feet; whole height, 104 feet. Average thickness of bark, $\frac{3}{4}$ inch. Number of layers twelve feet from the ground, 227. Average thickness of each layer, 0·06387 of an inch. The tree grew most rapidly during the first 100 years of its life; for the last 60 years, growth very slow.

	Bark	Outside wood.	Heart wood.	Wood of twigs
Potash	0·07	4·93	5·94	10·12
Soda	8·86	14·39	12·28	13·77
Chloride of sodium	0·08	0·12	0·12	0·26
Sulphuric acid	1·91	19·25	2·01	9·76
Carbonic acid	26·31	6·75	22·78	10·33
Lime	46·99	21·67	19·12	8·19
Magnesia	1·16	2·24	0·21	4·24
Phosphate of peroxide of iron.	1·01	1·61	1·90	0·80
Phosphate of lime	5·85	12·70	9·94	25·25
Phosphate of magnesia	0·84	2·44	2·76	1·20
Organic matter	4·01	3·60	6·01	7·20
Insoluble silica	1·20	5·80	10·70	1·10
Coal	1·80	1·70	5·20	3·20
Moisture		3·40		3·30
	100·09 S.	100·60 S.	98·97 S.	98·72

18. Miscellaneous Analyses.

1. *Leaves of the Iron-wood, collected September* 30. Yard of the State House.

Silica		10·500
Earthy phosphates :		
Phosphate of peroxide of iron	5·575	
Phosphate of lime	0·719	
Phosphate of magnesia	0·125	
Phosphate of silica	7·325	
Phosphoric acid	11·581	
		25·325
Lime		37·484
Magnesia		0·075
Potash		7·369
Soda		5·902
Chloride of sodium		1·900
Sulphuric acid		0·223
Carbonic acid		10·400
Organic matter		2·850
		102·028 S.
	PROPORTIONS.	
Water		54·680
Dry matter		45·320
Ash		4·260
Ash calculated dry		9·399 S.

2. *A species of foreign Rose-wood.* Color dark, and much used in ornamental cabinet work.

Silica	9·475
Earthy phosphates	4·150
Lime	61·189
Magnesia	0·527
Potash	0·791
Soda	4·185
Chloride of sodium	0·276
Sulphuric acid	0·051
Carbonic acid	20·205
Organic matter	3·175
	100·924 S.

3. *Bark of Maple twigs.*

Silica	1·25
Earthy phosphates	18·00
Carbonate of lime	53·35
Magnesia	1·65
Potash	9·45
Soda	5·71
Sulphuric acid	4·15
Chlorine	trace.
Organic matter	1·80
	95·36

II. FRUIT TREES.

1. PLUM (*Prunus domestica*).

Tree cut first of May.

PROPORTIONS.

	Bark of root.	Wood of root.	Bark of limbs.	Wood of limbs.
Percentage water	48·51	44·64	27·50	20·33
Percentage dry wood	51·49	55·36	72·50	79·67
Percentage ash	3·12 S.	0·24 S.	4·37 S.	0·38 S.

ANALYSIS.

	Plum pits*.	Bark of root.	Wood of root.	Bark of limbs.	Wood of limbs.
Potash	13·92	9·86	40·31	8·59	11·63
Soda	10·08	6·63		19·49	
Chloride of sodium	2·25	4·22	0·103	1·03	0·18
Sulphuric acid	6·11	5·22	4·64	4·09	20·34
Carbonic acid (not determined).					
Lime	23·30	22·74	0·17	39·42	8·12
Magnesia	4·80	0·98	0·20	3·76	6·56
Phosphate of peroxide of iron,	8·00	6·90	1·20	2·30	0·60
Phosphate of lime		7·62	31·98	7·50	24·99
Phosphate of magnesia		3·28	17·12	trace.	1·16
Organic matter	6·65	1·76	2·50	1·40	4·60
Insoluble silica	27·20	21·40	1·80	8·40	0·70
Coal		3·60	0·90		1·60
	102·31 S.	94·21 S.	100·923 S.	95·98 S.	80·53 S.

* This analysis was made with two grains of ash.

2. Peach (*Amygdala persica*).

Small seedling peach. Age of the tree, 23 years. Mean diameter, 3½ inches. Thickness of bark, ¼ inch. Growth rather slow. Average thickness of each layer, 0·0699 of an inch.

	Bark of trunk.	Wood of trunk.	Bark of root.	Wood of root.	Leaves.	Pits*.	Bark of limbs†.	Wood of limbs†.
Potash - -	1·20	7·11	3·162	8·58	12·41	18·47	8·85	19·21
Soda - -		11·15	1·92	15·92		5.21		8·11
Chloride sodium,	0·04	0·16	0·33	5·60		2·70	0·28	0·24
Chloride potassium,					0·36			
Sulphuric acid	4·19	1·51	3·44	0·58	12·12	15·12	6·18	8·07
Carbonic acid (not determined).								
Lime - -	42·17	23·26	38·48	0·11	14·77	16·80	31·98	24·64
Magnesia -	2·16	6·40	2·91	0·01	8·00	1·33	6·00	9·76
Phosph. perox. iron,	0·45	0·32		1·02	2·47	1·33	1·60	0·60
Phosphate lime,	18·79	29·19	10·40	18·10	10·44	17·98	8·50	13·20
Phosphate magnesia,	0·01	1·34		30·00	3·15	0·02	0·20	0·20
Organic matter,	3·30	5·20	3·60	2·55	0·86	6·61	5·00	8·40
Insoluble silica,	4·15	1·35	9·40	6·46	6·42	10·00	4·30	1·00
Coal - -			1·40		4·48		1·00	1·20
	109·04 S.	104·97 S.	104·562	89·02 S.	86·85 S.	128·77 S.	99·03 S.	104·99 S.

Leaves of the Peach tree, July 22.

Carbonic acid - - - - - -	13·300
Silicic acid - - - - - -	0·600
Phosphates - - - - - -	9·600
Lime - - - - - - - -	16·220
Magnesia - - - - - - -	5·900
Potash - - - - - - -	14·280
Soda - - - - - - -	21·220
Chlorine - - - - - - -	5·120
Sulphuric acid - - - - - -	4·420
Organic acids - - - - - -	7·900
	98·560 S.

* Analysis made with two grains of ash.

† Peach limbs half an inch in diameter.

Leaves affected with the yellows.

Carbonic acid	13·200
Silicic acid	0·800
Sulphuric acid	4·430
Phosphates	11·600
Lime	14·300
Magnesia	5·300
Potash	14·440
Soda	22·280
Chlorine	4·740
Organic acids	4·300
	99·390 S.

3. Apple (*Pyrus malus*).

Sweet apple. Age of the tree, 19 years. Diameter of section taken for analysis, 6 inches. Thickness of the bark, ⅛ inch. Average thickness of each layer, 0·1447 of an inch.

	Bark.	Outside wood.	Heart wood.	Bark of root.	Wood of root.
Potash	0·44	3·288	2·75	0·66	15·07
Soda	1·53	3·33	1·62	11·38	21·99
Chloride of sodium	0·30	0·33	0·51	0·10	0·11
Sulphuric acid	38·39	12·21	22·17	30·83	1·84
Carbonic acid	49·56	15·79	38·98		
Lime	1.86	15·56	2·66	1·00	11·64
Magnesia	2·56	3·52	2·93	8·72	0·16
Phosphate of peroxide of iron,	3·60	37·50	24·40	0·72	0·91
Phosphate of lime				6·39	13·96
Phosphate of magnesia					31·35
Organic matter	3·35	3·20	3·60	1·80	1·20
Insoluble silica	1·26	0·45	0·20	2·86	1·46
Coal	1·26	0·35	0·01	0·72	
	104·21	95·528	99·83	65·18 S.	99·69 S.

4. Rose Tree.

	Bark.	Wood.
Potash	5·12	11·60
Soda	8·52	5·99
Chloride of sodium	3·20	3·00
Sulphuric acid	5·00	6·00
Carbonic acid	28·79	15·87
Lime	22·56	10·46
Magnesia	2·86	3·80
Phosphates	15·30	31·00
Phosphate of iron	1·60	
Organic matter	3·30	3·00
Silica	2·40	2·30
Coal	1·00	0·50
Moisture	2·00	1·00

5. Miscellaneous Analyses.

1. *Leaves of the Lady Apple, picked May* 23. Flowers just fallen.

Carbonic acid	8·55
Silicic acid	4·65
Sulphuric acid	10·12
Phosphates	26·60
Lime	3·38
Magnesia	2·74
Potash	27·17
Soda	11·83
Chlorine	0·79
Organic acids	3·60
	99·43 S.

2. *Leaves of the Pear-tree, picked May* 23. Flowers just fallen.

Carbonic acid	11·560
Silicic acid	1·750
Phosphates	25·050
Lime	4·715
Magnesia	4·500
Potash	18·950
Soda	15·190
Sulphuric acid, chlorine and organic acids not determined.	
	81·715 S.

3. *Leaves of the Oxheart Cherry, picked May* 23. Flowers just fallen.

Carbonic acid	11·450
Silicic acid	1·850
Phosphates	26·650
Lime	3·941
Magnesia	3·465
Potash	23·757
Soda	12·365
Sulphuric acid, chlorine and organic acids not determined.	
	83·478 S.

4. *Leaves of the Early Harvest Apple, collected September* 30. Bearing fruit.

Silica		5·775
EARTHY PHOSPHATES:		
Phosphate of peroxide of iron	4·875	
Phosphate of lime	1·416	
Phosphate of magnesia	trace.	
Silica	5·125	
Phosphoric acid	5·359	
		16·775
Lime		36·398
Magnesia		0·075
Potash		13·179
Soda		11·616
Chloride of sodium		0·060
Sulphuric acid		0·137
Carbonic acid		15·200
Organic matter		2·850
		101·065 S.
PROPORTIONS.		
Water		54·341
Dry		45·659
Ash		4·194
Calculated dry		9·163 S.

5. *Leaves of the Bergamot Pear, collected September* 30. Bearing fruit.

Silica		4·250
EARTHY PHOSPHATES:		
Phosphate of peroxide of iron	4·600	
Phosphate of lime	7·559	
Phosphate of magnesia	0·660	
Silica	0·450	
Phosphoric acid	3·781	
		16·550
Lime		39·853
Magnesia		5·920
Potash		8·793
Soda		
Chlorine		0·554
Sulphuric acid		4·464
Carbonic acid		17·125
Organic matter		3·000
		100·509 S.
PROPORTIONS.		
Water		56·138
Dry		43·862
Ash		3·260
Calculated dry		7·514 S.

6. *Leaves of the Large Yellow Spanish Cherry, collected September* 30.

Silica	4·225
Phosphates	37·175
Lime	21·957
Magnesia	3·195
Potash	13·948
Soda	1·657
Chloride of sodium	0·410
Sulphuric acid	10·260
Organic matter	7·650
	100·577 S.

PROPORTIONS.

Water	58·628
Dry	41·372
Ash	3·434
Calculated dry	8·300 S.

7. *Leaves of the Catawba Grape, collected September* 30. Fruit abundant.

Silica			23·150
EARTHY PHOSPHATES:			
Phosphate of iron	6·750		
Phosphate of lime	11·648		
Phosphate of magnesia	0·150		
Silica	4·050		
Phosphoric acid	6·152		
			28·750
Lime			26·258
Magnesia			5·330
Potash			1·710
Soda			2·983
Chloride of sodium			0·305
Sulphuric acid			1·426
Carbonic acid			8·900
Organic matter			3·450
			102·262 S.

PROPORTIONS.

Water	11·169
Dry	28·831
Ash	2·282
Calculated dry	7·915 S.

8. *Leaves of the Catawba Grape, picked June 2. Nearly full grown.*

Carbonic acid	3·050
Silicic acid	29·650
Sulphuric acid	2·062
Phosphates	32·950
Lime	4·391
Magnesia	1·740
Potash	13·394
Soda	9·698
Chlorine	0·741
Organic acids	2·250
	99·926 S.

9. *Fruit of the Black Walnut.*

	Rind.	Shell.	Meat.
Silica	1·35	0·40	1·85
Earthy phosphates	15·60	18·50	40·95
Carbonate of lime	23·75	5·60	0·10
Magnesia	1·55	0·10	trace.
Potash	41·43	47·00	22·99
Soda	7·12	10·21	4·98
Sulphuric acid	2.65	9·84	11·05
Chlorine	1·60	2·15	trace.
Organic matter	1·30	5·40	5·00
Alkaline phosphates			9·10
	96·35	99·20	96·02

10. *Currant leaves and flowers.*

Two hundred grains of the leaves gave 4·00 grs. of ash, and the same weight of the flowers gave 2·95 of ash; but the analysis was not finished. The leaves are particularly rich in soda and the phosphates. The analysis of the flowers was undertaken for the purpose of determining the amount of silica, an element which I have found rather abundant in floral organs, particularly the petals. In the ash of the blossom of the currant I found 9 per centum of silica, and 28 per centum of potash, a result which indicates the predominance of potash rather than soda in these organs.

N. B. It is due me to state, that in the following analyses having my initial, in the two preceding sheets, the carbonic acid was not obtained, viz: Analyses of the Hemlock and Sugar Maple, page 319; those of the Red Elm, p. 323; those of the Hickory, p. 325; those of the Black Birch, p. 326; and those of the Red Birch; p. 328. These are the only cases, in my analysis, where the carbonic acid is inserted without being actually determined: it was retained in these instances through mistake. In the following analyses having my initial, in the present sheet, the carbonic acid was not determined, and is not inserted, viz: Analyses of the Plum, p. 330; those of the Peach, top of p. 331; and of the root of the Apple tree, p. 332. J. H. Salisbury.

ANALYSES OF THE ASH OF THE LEAVES, BARK AND WOOD OF THE CORNUS FLORIDA.

Made by Dr. GEORGE HAND SMITH, of Rochester.

	Leaves.	Bark.	Wood.
Carbonic acid - - - - -	17·250	17·479	15·396
Silicic acid . - - - - -	4·850	4·785	6·200
Phosphates - - - - -	24·850	18·500	31·850
Sulphuric acid - - - -	3·050	1·750	1·925
Lime - - - - - -	33·493	44·470	21·391
Magnesia - - - - -	1·240	1·150	0·450
Potash - - - - - -	5·561	1·390	11·373
Soda - - - - - -	6·820	4·370	5·116
Chlorine - - - - -	0·627	0·246	0·444
Organic acids - - - - -	2·150	4·860	4·835
	99·892	99·000	98·980

OBSERVATIONS ON THE PRECEDING ANALYSES.

It is obvious from the foregoing analyses of the ash of fruit and forest trees, that a large supply of inorganic matter is essential to a vigorous growth. In fruit trees this is particularly the case. These enjoy, in a far less degree, the power to recruit themselves from a supply by their own waste or debris. In a forest, the leaves and bark fall to the ground and decay, and in due time return to that state which fits them for food. In an orchard, however, the usual mode of managing the grounds prevents an accumulation of food in this way. Hence they are placed in the same position as other crops, as to their effect in removing the nutriment from the soil; and hence it is essential to their vigor, that a regular supply be furnished them. The substances which trees require are evidently calcareous and alkaline elements for the wood, and phosphatic and alkaline elements for the fruit. Lime exists in a large percentage in the bark. A compost of peat, lime and wood ashes, or the ordinary barnyard manures, will be always useful; and a large outlay in these matters will repay the expense in the quality and size of the fruit. Ample experience proves the great utility of this mode of treating fruit trees; and fruit trees which are neglected, and left to shift for themselves, will in time cease to grow, and will moreover be preyed upon by lichens and fungi.

THE BEST TIME FOR CUTTING TIMBER, &c.

Experience has proved that trees for timber, if cut at one season of the year, are far more durable than if cut at another. Various reasons have been suggested why this is so, and it is not perhaps yet fully determined; still, as the time which experience has pointed out as the best for durability is during the autumn, it is generally supposed that this property is modified by the amount of sap in the trunk, and the maturity of the wood itself. In the spring, or at any early period of it, the trunk of most trees is pressed with the ascending sap. The leaves as yet are still folded in the bud, and the surfaces for exhalation are only sufficient to carry off very slowly the watery part of the sap. Even after the leaves have expanded, or until mid-summer has arrived, the tree abounds in juices. When, however, the dry and sultry summer has arrived, and the new wood and buds have been matured and formed, the watery part of the sap is mostly exhaled, and probably too the circulation is less active as the leaves become sere.

It is stated by Mr. Emerson, author of the valuable report on the trees and shrubs of Massachusetts, that the soft maple cut in September is three times more lasting than ash or walnut cut in the winter; and from numerous inquiries which he has made in various quarters, and from information obtained from reliable sources, it seems he has established the fact that autumn is the time for cutting timber. When it is determined to cut timber, it is of considerable importance to strip off the bark in the spring, that the body of the tree may dry during the summer. When, however, it is an object to reproduce a forest from the remaining stumps, the winter, or the very first of spring, is much more favorable to the growth of sprouts.

There are then two seasons for cutting wood: if it is expected to last, it must be cut the last of summer, or during the early part of autumn; if it is wished to clothe the surface with a new growth of trees, the cutting must be made late in winter. It is, however, possible to modify these arrangements: if, for example, the wood is designed for timber, if it is deprived of its bark in the spring, it may be allowed to stand and season till winter arrives, which is a period when farmers have less to do than in the summer or autumn.

In seasoning, wood retains an amount of water which may be regarded as its constitutional supply. This constitutional water is very important; for, upon its presence some of the most valuable properties of the wood depend. I refer to elasticity and strength. If wood, for example, is dried in a water bath at 212° till it ceases to lose weight, its elasticity and strength is very much diminished. Hickory, when dried in this way becomes as brittle as pine. In ordinary seasoning, or in steaming, I believe the strength of wood is not diminished. This observation may not be of much practical importance, as this last plan of seasoning is rarely followed. The amount of water varies, as will be observed, in different species of trees, as well as in herbaceous plants.

In another point of view, the amount of water is important to be known, for the difference between taking green and dry wood to market, as well as in its consuming, is very great; and so also, as ample experience proves, there is a material difference in burning green and dry wood. The quantity of water in the wood varies from 20 to 50 per centum, and probably the average amount will not differ much from 35 or 40 per centum. This water is not only of no use to the fire-wood, but it is prejudicial, as it must be dissipated by heat, in which act heat or caloric becomes latent and lost, especially if the wood is consumed upon a hearth or in a stove.

In addition to the effect of water in diminishing the combustibility of wood, the alkalies have also considerable influence of this kind. Elm, which is a potash wood, burns with less freedom than hickory, which contains much lime. It is, however, possible that the size of the pores of wood may modify its combustibility. Black oak is a notable instance of a slow and drizzling combustion : the pores are large and numerous, from which the watery sap continually oozes.

ADDITION TO CHAPTER VIII.

ANALYSIS of several specimens of Salina salt, made for the purpose of comparing its purity with that of foreign salt; together with an analysis of the waste of the sediment, for the purpose of determining its value for manure.

1. *Coarse solar salt obtained from a store in Albany.*

Chloride of sodium (pure salt)	92·980
Carbonate of lime	0·010
Sulphate of lime	1·315
Sulphate of magnesia	0·035
Sulphuric acid	0·669
	95·019

2. *Refined salt for the use of the dairy.*

1. W. H. PORTER's brand.

Chloride of sodium	97·466
Silica	0·010
Sulphate of lime	1·799
Lime	0·058
Magnesia	0·082
	99·415

2. J. P. HASKIN's brand.

Chloride of sodium	95·819
Silica	0·020
Sulphate of lime	1·753
Lime	0·043
Magnesia	0·074
Water	1·190
	98·899

3. Brand of H. GREENMAN & Co., and of H. W. NOLTON & Co. which is substantially the same.

Chloride of sodium	95·113
Sulphate of lime	0·402
Magnesia	0·120
Water	1·500
	97·135

4. SMITH's refined dairy salt.

Chloride of sodium	98·896
Chloride of magnesium	0·139
Sulphate of lime	0·375
Insoluble matter	trace.
Water	0·500
	99·900

This is probably as pure a manufacture as can be obtained. Taking out the water, there is but a trifle over one half per centum of what may be regarded as impurities; which amount, in reality, can have no prejudicial influence as a preserver of organic bodies. The main or most important quality is dryness, inasmuch as the power of salt to take from meat a part of its constitutional water depends upon this quality.

3. *Analysis of the waste called Pan-scale.*

Chloride of sodium	73·922
Chloride of lime	7·469
Chloride of magnesia	1·683
Sulphate of lime	12·369
Silica	0·200
Organic matter	1·500
	97·143

It is evident from this analysis, that the waste of the salt-works, if this specimen is a fair example, is very valuable as a fertilizer, and hence ought to be saved. Indeed it seems that it might be redissolved, and the pure salt extracted. If used for a manure, it can be transported farther than gypsum, inasmuch as its composition is more valuable.

It is a matter of great importance to the farmers of New-York, to know that their own salt-works furnish a material equal to any in market, for curing meat and butter, and for other domestic purposes.

It is evident from the foregoing analyses, which were undertaken at the request of the Secretary of the New-York State Agricultural Sociery, that the salt of Salina contains no substance injurious to dairying purposes. The only source of danger is that the salt may be damp. Wet salt is entirely unsuitable for preserving animal substances; inasmuch as the principal operation of salt, as a preserver, is due to its power of absorbing water from the material to be preserved. Hence salt should be always thoroughly dried. If this rule is observed, in every case where it is doubtful as it regards the Onondaga salt of the brands given above, let it be dried. I may state that an individual has used this salt for 30 years in packing meat, without having in any case a spoilt barrel; and being a merchant, extensive experience in this way is certainly sufficient testimony to place the Onondaga salt with the best in market, for private and public purposes.

CONCLUSION.

The first volume relating to the agriculture of New-York treats of the soils and the constitution of the rocks, and their relations to each other. It was designed to prepare the way for the present volume. Although it is perhaps as full as could be expected, still much at this time might be done to improve it and render it more useful, or at least better adapted to the wants of farmers.

The statistics of agriculture are mostly omitted; and when introduced, it was for the purpose of comparing premium crops grown upon different soils, and in different parts of the State. This volume contains too much, perhaps, which relates to geology proper, but which was introduced for the purpose of giving an epitome of what was known upon the subject, this information being spread over the four volumes prepared by the gentlemen who had charge of this department of the Survey.

In the part relating mostly to geology, I introduced an extended account of the Taconic System. I felt justified in this course, for the reason that in this State these rocks present a highly important feature in its geology. It is not an inconsiderable part of the State over which these rocks prevail, and hence as a geological fact the existence of this system could not be passed over by one who was well satisfied as to his position; and although this position might be discredited, and a reputation for sagacity might be hazarded by a committal as to the fact, still I should not have felt justified in the mere statement of a conjecture or possibility. It is, however, proper to state, for the benefit of those persons who are unacquainted with the controversy upon this subject, that geologists are still divided upon the fact. Among those who have been the most strenuous in opposition to it, is my colleague Mr. JAMES HALL; as he has made it the subject of remark in his volume of Palæontology, and has opposed the views which I maintained in the volume referred to, on the ground that the fossils which I there described were those which are common to the Hudson-river group, I deem it a duty I owe to myself to say that a committee of the American Association of Geologists and Naturalists has reported adversely to Mr. HALL's position. This removes thus far the supposed or theoretical objections to my views, and favors the position I had taken as it regards the reality of this ancient system of sedimentary rocks. Other assumptions in the volume of Palæontology would be noticed here, were it not that I propose to resume the subject at a future time.

This volume, it is hoped, contains matter of a practical kind, in a form which has not been before accessible to the farmers of this country. The analyses, though numerous, have been conducted with as much care as it was possible to bestow; and I may state that all the weighings of products, without exception, have been to the hundredth of a grain.

The volume contains original analyses; and the composition of most of these substances had not been previously investigated in this country, except to a very limited extent. In preparing the work for publication, I could not feel satisfied with giving the results of others; although they may have been obtained by chemists before whom I could lay no claim to distinction, still our own soils and grains, our own products, were the ones which required this kind of labor. This view of the subject has always been entertained by myself; and though I felt an interest in the analyses which have been made in Europe, still they do not, as it appears to me, give that full information which we want. I have been, as will be seen, influenced by this view of the subject in taking up for analysis so many kinds of food, and other productions of the earth, and attempting thereby to furnish that kind of information which seemed so important respecting their composition. I have not attempted to deduce, from these analyses, all the inferences which may clearly be drawn from them. Hence they stand more as facts, which may be used in various ways for illustrating the economy of the vegetable kingdom.

APPENDIX.

TEMPERATURE OF THE SOIL,

AS INDICATED BY A SERIES OF OBSERVATIONS AT ALBANY, N. Y., FOR TWENTY MONTHS, BEGINNING WITH MAY, 1847, AND ENDING WITH DECEMBER 1848.

THE importance of determining terrestrial temperature is felt more and more as advances are made in scientific agriculture and gardening. We have no space here for general observations on the utility of the subject.

Albany is in latitude 42 deg. 39 min. The observed mean temperature of the place is 48 deg. 47 min., at an elevation of 130 feet above tide. The elevation of the place where the following observations were made is about 100 feet above tide, in the open space in the rear of the old State House, where the morning sun shines early, and continues till the after part of the day, when the spot is shaded by the walls upon the west side of the area.

MAY.

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air 4 feet above surface.	Air 4 inches above surface, naked soil.	Air 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
1	43	....	42	....	....	N.	56	....	47	....	N.	..	....	..	....	S.	53	....	50	....	S. W.
2	41	....	46	....	....	S.	45	....	46	....	S.	..	....	..	....	N. W.	46	....	46	....	S.
3	44	....	45	....	....	W.	53	....	46	....	N. W.	53	....	47	....	N. W.	48	....	48	....	N. W.
4	39	....	45	....	....	W.	58	....	47	....	W.	60	....	49	....	N. W.	56	....	50	....	N. W.
5	40	....	47	....	....	W.	62	....	48	....	W.	67	....	49	....	N. W.	61	....	51	....	N. W.
6	43	....	48	....	....	N. W.	69	....	49	....	N. W.	68	....	54	....	N. W.	62	....	53	....	N.
7	45	....	51	....	....	W.	73	....	52	....	N.	72	....	54	....	N. W.	66	....	55	....	N. W.
Mean,	39 7/8	....	46	....	....	.....	59 1/2	....	47 7/8	....	.....	65	....	50 1/2	....	.....	56 1/2	....	50	....	.....
Highest,	45	....	48	....	....	.....	93	....	52	....	.....	72	....	54	....	.....	66	....	55	....	.....
Lowest,	40	....	42	....	....	.....	56	....	46	....	.....	52	....	47	....	.....	46	....	46	....	.....

OBSERVATIONS.—1. Morning clear. Afternoon few thin clouds. 2. Cloudy. Rainy. Moderate breeze. 3. Morning rainy. Afternoon thick clouds. Stiff n. w. breeze. 4. Heavy dew. Afternoon few clouds. Stiff n. w. breeze. 5. Heavy dew. Few clouds. Slight breeze. 6. Morning clear. Heavy dew. Afternoon few clouds. Moderate breeze. 7. Morning clear. Smoky. Heavy dew. Afternoon few clouds. Slight breeze.

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
8	50	54	53	....	....	N.	60	56 1/2	53	....	N.	62	57	54	....	N. W.	60	57	54	....	N. W.
9	54	53 1/2	53	....	....	N.	68	58	54	....	N. W.	72	65	56 1/2	....	N. W.	68	63	57	....	N. W.
10	52	55 1/2	55	....	....	N. W.	73	62	58	....	S.	74	65	58	....	S. W.	68	62	59	....	S. W.
11	58	57	57	57	....	S. W.	74	62	58	....	S. W.	75 1/2	62	58	....	S.	69	64	62	....	S.
12	56	55	57	55	....	S.	72	62 1/2	62	....	S.	69	65	60	....	E.	66	63	59 1/2	....	N.
13	53	55	59	49	....	N.	70	63	62	....	N.	72	65	58	....	N.	64	62	60	....	N.
Mean,	53 7/8	55	55 1/4	53 3/8	....	.....	69 1/4	60 3/4	67 7/8	....	.....	71	69 1/4	57 1/8	....	.....	65 7/8	61 3/8	58 1/8	....	.....
Highest,	58	57	59	57	....	.....	74	63	62	....	.....	75 1/4	65	60	....	.....	69	64	62	....	.....
Lowest,	52	53 1/2	53	49	....	.....	68	56 1/4	53	....	.....	62	57	54	....	.....	60	57	54	....	.....

OBSERVATIONS.—8. Cloudy. (
rate breeze. 9. Few clouds. s
clouds. Warm. Currants in flo
Strong breeze. Variable. 13.

JUNE.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.			5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.		
	Surface.	4 inches below the surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
1	52	54	55	69	63	57	67	63	58	63	63	58	52	53	54	68	69	55	68	63	57	63	62	58
2	57	58	58	81	65	58	76	70	62	62	64	61	56	56	56	74	64	58	80	69	59	60	64	60
3	52	57	56	74	67	60	66	65	60	64	64	61	51	54	56	74	64	58	66	63	58	63	62	59
4	60	60	60	73	64	60	76	68	60	62	63	60	59	58	58	73	62	59	80	67	60	62	62	60
5	53	57	58	77	62	60	74	70	61	61	64	61	50	54	58	69	59	58	77	66	60	58	62	59
6	54	58	59	72	66	60	75	66	60	64	65	60	52	54	57	71	66	59	75	67	59	64	64	59
7	54	59	60	75	63	60	75	72	64	64	68	65	50	55	57	76	62	61	80	70	64	64	63	62
Mean,..	54	57	58	74	64	59	72	67	60	62	64	60	52	54	56	72	63	58	75	66	59	62	62	59
Highest	60	60	60	81	67	60	76	72	64	64	68	65	59	58	58	76	69	61	80	70	64	64	64	62
Lowest,	52	54	55	69	62	57	66	63	58	61	63	58	50	53	54	68	59	55	66	63	57	58	62	58

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
1	52	52	52	....	52	S. E.	64	65	64	....	S.	68	68	68	....	S.	66	64	64	....	S. E.
2	58	57	57	....	....	W.	68	70	69	....	S. W.	69	70	69	....	S. W.	64	60	58	....	S. W.
3	52	49	49	49	....	W.	71	70	70	....	S.	68	66	66	....	S.	66	65	64	....	S.
4	60	60	61	....	58	S. W.	70	69	69	....	S. W.	70	70	70	....	W.	62	62	62	....	N. W.
5	50	49	48	....	....	N.	64	63	63	....	S. W.	65	66	65	....	W.	56	55	55	....	N. W.
6	53	52	52	52	....	N. W.	68	68	68	....	N.	74	72	70	....	N. W.	67	64	62	....	W.
7	52	49	48	48	....	N.	73	74	74	....	E.	74	76	74	....	E.	68	64	64	....	S.
Mean, ...	53	52	52	....	....	.....	66	67	66	....	.....	69	69	68	....	.....	64	62	61	....	.....
Highest, ...	60	60	61	....	....	.....	73	74	74	....	.....	74	76	74	....	.....	68	65	64	....	.....
Lowest,....	50	49	48	....	....	.....	64	63	63	....	.....	65	66	65	....	.....	56	55	55	....	.....

OBSERVATIONS.—1. Morning cloudy. Slight shower. Soil wet 4 inches deep. Occasional sunshine during day. Slight wind. 2. Morning cloudy. A fine thunder shower last night. Soil very wet. At 7 p. m. clear moderate breeze. 3. Morning few clouds. Afternoon cloudy. Moderate wind. 4. Morning cloudy. Rainy. Soil wet 9 inches deep. Afternoon few clouds. Warm. The leaves of the Button wood (Platanus occidentalis) begin to die. 5. Few floating clouds. Slight breeze. Pleasant. 6. Few floating clouds. Moderate breeze. Pleasant. Dew. The leaves of the Thorn bush (Cratægus coccinea) begin to die. 7. Clear. Slight breeze. Warm. Light dew.

MAY.

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air 4 feet above surface.	Air 4 inches above surface, naked soil.	Air 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
1	43	....	42	....	....	N.	56	....	47	....	N.	..	....	..	....	S.	53	....	50	....	S. W.
2	41	....	46	....	....	S.	45	....	46	....	S.	..	....	..	....	N. W.	46	....	46	....	S.
3	44	....	45	....	....	W.	53	....	46	....	N. W.	53	....	47	....	N. W.	48	....	48	....	N. W.
4	39	....	45	....	....	W.	58	....	47	....	W.	60	....	49	....	N. W.	56	....	50	....	N. W.
5	40	....	47	....	....	W.	62	....	48	....	W.	67	....	49	....	N. W.	61	....	51	....	N. W.
6	43	....	48	....	....	N. W.	69	....	49	....	N. W.	68	....	54	....	N. W.	62	....	53	....	N.
7	45	....	51	....	....	W.	73	....	52	....	N.	72	....	54	....	N. W.	66	....	55	....	N. W.
Mean, ...	39 7/7	....	46	....	....	.....	59 1/7	....	47 3/7	....	.....	65	....	50 3/7	....	.....	56 3/7	....	50	....	.....
Highest, ...	45	....	48	....	....	.....	93	....	52	....	.....	72	....	54	....	.....	66	....	55	....	.....
Lowest, ...	40	....	42	....	....	.....	56	....	46	....	.....	52	....	47	....	.....	46	....	46	....	.....

OBSERVATIONS.—1. Morning clear. Afternoon few thin clouds. 2. Cloudy. Rainy. Moderate breeze. 3. Morning rainy. Afternoon thick clouds. Stiff n. w. breeze. 4. Heavy dew. Afternoon few clouds. Stiff n. w. breeze. 5. Heavy dew. Few clouds. Slight breeze. 6. Morning clear. Heavy dew. Afternoon few clouds. Moderate breeze. 7. Morning clear. Smoky. Heavy dew. Afternoon few clouds. Slight breeze.

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
8	50	54	53	....	....	N.	60	56 1/2	53	....	N.	62	57	54	....	N. W.	60	57	54	....	N. W.
9	54	53 1/2	53	....	....	N.	68	58	54	....	N. W.	72	65	55 1/2	....	N. W.	68	63	57	....	N. W.
10	52	55 5/6	55	....	....	N. W.	73	62	58	....	S.	74	65	58	....	S. W.	68	62	59	....	S. W.
11	58	57	57	57	....	S. W.	74	62	58	....	S. W.	75 1/2	62	58	....	S.	69	64	62	....	S.
12	56	55	57	55	....	S.	72	62 1/2	62	....	S.	69	65	60	....	E.	66	63	59 1/2	....	N.
13	53	55	59	49	....	N.	70	63	62	....	N.	72	65	58	....	N.	64	62	60	....	N.
Mean, ...	53 7/7	55	55 1/2	53 3/5	....	.....	69 1/6	60 3/5	67 7/7	....	.....	71	69 1/2	57 1/6	....	.....	65 7/7	61 5/6	58 1/2	....	.....
Highest, ...	58	57	59	57	....	.....	74	63	62	....	.....	75 1/2	65	60	....	.....	69	64	62	....	.....
Lowest, ...	52	53 1/2	53	49	....	.....	68	56 1/2	53	....	.....	62	57	54	....	.....	60	57	54	....	.....

OBSERVATIONS.—8. Cloud
rate breeze. 9. Few clo
clouds. Warm. Currants i
Strong breeze. Variable. ...

MAY.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND. 5 o'clock a.m. Surface.	5 o'clock a.m. 4 inches below surface.	5 o'clock a.m. 9 inches below surface.	12 oclock m. Surface.	12 oclock m. 4 inches below surface.	12 oclock m. 9 inches below surface.	7 o'clock p.m. Surface.	7 o'clock p.m. 4 inches below surface.	7 o'clock p.m. 9 inches below surface.	3 o'clock p.m. Surface.	3 o'clock p.m. 4 inches below surface.	3 o'clock p.m. 9 inches below surface.	OBSERVATIONS.
14	....	53	55	80	64	57	79	68	57	64	63	58	Heavy dew. Few thin clouds. Soil dry.
15	42	53	55	72	62	57	80	70	60	65	63	59	Heavy dew. Few thin clouds. Smoky.
16	46	53	55	74	66	58	75	67	62	62	62	59	Clear. Smoky. Slight breeze.
17	41	49	53	76	65	57	88	73	58	66	65½	58½	Few thin clds. Smoky. Slight breeze. Horse chesnut in flo.
18	53½	55	56	66	60	57	68	62	58	58	58	56½	Morn. few thin clds. Smoky Afternoon cldy. Stiff n br'ze.
19	52⅝	55	55	72	60	56	75	61	57	64	58½	57⅛	Forenoon cldy Rainy. Afternoon few clds. Soil wet 1 in d'p.
20	47	53	55	80	64	59	78	77	58	64	63	58	Clear. N. breeze. Smoky.
21	50	54	56					77	58	60	62	50	Clear. Smoke. Strong S. breeze.
22	53	55	56	62½	57	56				63	55	57	Cloudy. Strong S. wind. Slight sprinkle.
Mean,....	48	53⅛	55	85	82¾	57	77⅞	69⅜	59⅜	62⅞	61	57⅞	
Highest, .	53	55	56	80	66	59	86	77	62	66	65	59	
Lowest,..	41	49	53	64	62	56	68	61	58	58	58	57	

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m. Air, 4 feet above surface.	5 o'clock a. m. Air, 4 inches above surface, naked soil.	5 o'clock a. m. Air, 4 inches above surface, grass land.	5 o'clock a. m. Dew.	5 o'clock a. m. Rain.	5 o'clock a. m. Wind.	12 o'clock m. Air, 4 feet above surface.	12 o'clock m. Air, 4 inches above surface, naked soil.	12 o'clock m. Air, 4 inches above surface, grass land.	12 o'clock m. Rain.	12 o'clock m. Wind.	3 o'clock p. m. Air, 4 feet above surface.	3 o'clock p. m. Air, 4 inches above surface, naked soil.	3 o'clock p. m. Air, 4 inches above surface, grass land.	3 o'clock p. m. Rain.	3 o'clock p. m. Wind.	7 o'clock p. m. Air, 4 feet above surface.	7 o'clock p. m. Air, 4 inches above surface, naked soil.	7 o'clock p. m. Air, 4 inches above surface, grass land.	7 o'clock p. m. Rain.	7 o'clock p. m. Wind.
14	48	44	40	40	....	N.	70	71	....	....	N.	73	74	72	....	N.	68	65	....	....	N.
15	46	44	40	40	....	N.W	71	70	68	....	N.W	75	74	72	....	N.W	69	66½	64	....	N.W
16	47	44	43	....	....	S.W	74	74	71	....	S.W.	74	74	73	....	S.W.	66	63	62	....	S.W
17	45	42½	42	....	....	N.	70	71	70½	....	S.	73	74¼	....	....	S.	70	64	....	....	S.
18	54	53½	53½	....	....	N.	75	65	....	....	N.	61	61	....	....	N.	56	56	....	....	N.
19	50	51	51	....	53	N.W	65	66	....	....	N.	66½	66½	....	....	N.	59	58½	....	....	N.
20	48	47	56	45	....	N.	70	72	....	....	N.	72	72	....	....	N.	67	59	....	....	N.
21	56	52	52½	....	....	S.W	....	....	....	....	S.	74	75	....	....	S.	65	67	58	....	S.
22	54	54	53½	52	....	S.	62	62	62	....	S.	....	....	....	....	S.	63	65	62	....	S.
Mean, ...	49⅞	48¼	47⅞	....	....	....	68⅜	68	67	....	....	61	71	72⅛	....	....	65	62½	61	....	....
Highest, ...	56	53	56	....	....	....	74	74	71	....	....	75	75	73	....	....	70	68	64	....	....
Lowest, ...	41	44	40	....	....	....	65	62	62	....	....	61	61	....	....	....	56	56	58	....	....

JUNE.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a.m			12 o'clock m.			3 o'clock p.m			7 o'clock p m			5 o'clock a.m			12 o'clock m			3 o'clock p.m			7 o'clock p.m		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
23	64	64	64	74	69	65	82	74	67	72	72	66	62	62	62	71	66	63	86	76	64	71	71	66
24	62	64	64	81	68	66	84	76	66	72	72	68	60	62	63	81	66	64	85	75	64	72	72	66
25	64	63	66	84	74	68	85	76	70	76	74	69	62	64	65	85	73	67	88	80	69	76	76	69
26	69	69	68	82	71	68	78	75	71	72	70	68	68	67	66	83	72	69	78	75	69	72	72	68
27	68	68	66	78	70	68	86	78	72	74	74	70	66	66	64	80	70	66	88	84	67	74	76	69
28	67	68	68	87	76	71	93	80	74	76	76	72	67	67	67	88	74	69	94	30	73	77	76	71
29	69	70	69	68	68	68	67	68	68	66	67	68	68	68	68	68	68	67	67	68	67	66	67	67
30	64	66	67	72	70	68	84	74	68	68	70	68	61	64	66	72	70	66	93	76	66	68	71	68
Mean, .	65 7/8	66 1/2	66 1/2	78	70 3/4	67 1/2	82 3/8	75 1/8	69 1/2	72	71 7/8	68 3/4	44 1/2	65	65 1/8	78 1/2	69 7/8	66 3/8	84 7/8	76	67 3/8	78	72 3/8	68
Highest	69	70	69	87	76	71	93	80	74	76	76	72	68	68	68	66	74	69	94	84	73	77	76	71
Lowest,	44	63	64	68	68	65	67	68	66	66	67	66	60	62	62	68	66	63	67	68	64	66	71	66

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
23	62	62	62	62	....	N.	71	72	71	....	N. W.	76	76	78	....	W.	70	70	69	....	W.
24	63	60	60	58	....	N. E.	77	76	76	....	S. W.	82	82	82	....	S. W.	73	71	70	....	W.
25	64	63	63	62	....	N.	84	84	84	....	S.	83	84	83	....	W.	78	79	77	....	S. W.
26	70	69	69	68	....	S. W.	81	82	83	....	S. W.	76	75	75	....	S.	75	74	73	....	S.
27	72	70	70	66	....	W.	82	80	80	....	W.	86	87	84	....	W.	78	74	73	....	S. W.
28	68	68	68	66	....	N.	84	84	84	....	W.	86	87	86	....	W.	77	75	75	....	S. W.
29	68	68	67	....	....	N.	66	66	66	61	N.	66	66	66	69	N. W.	65	65	65	....	N. W.
30	60	61	61	61	....	N. W.	74	74	74	....	N.	76	78	76	....	N.	69	68	67	....	N.
Mean, ...	65 3/8	65 1/8	65 1/8	....	....	.....	77 3/8	77 1/8	77 1/8	....	.....	78 3/8	70 7/8	78 1/2	....	.....	73 1/8	71 1/8	71 1/8	....	.....
Highest, ...	72	70	70	....	....	.....	84	84	84	....	.....	86	87	86	....	.....	78	77	77	....	.....
Lowest, ...	60	61	60	....	....	.....	66	66	66	....	.....	66	66	66	....	.....	65	65	65	....	.....

JUNE.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clk a. m.			12 o'clock m.			7 o'clk p. m.			3 o'clk p. m.			5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
15	56	57	60	56	58	59	56	58	58	55	57	58	50	54	59	55	55	56	53	55	57	52	53	56
16	53	55	57	76	64	58	....	....	....	58	62	60	50	53	56	74	60	56	....	....	....	57	60	58
17	55	57	59	78	64	61	74	70	62	....	....	....	52	54	56	74	60	58	80	73	59	....	....	....
18	56	60	61	74	66	62	78	72	65	66	67	65	53	56	59	71	68	59	83	75	60	65	66	63
19	61	62	62	62	62	61	61	64	61	59	60	61	60	60	60	61	60	60	60	60	60	58	59	60
20	62	60	60	68	63	62	66	64	62	64	64	62	60	58	58	68	64	60	66	64	60	64	64	61
21	62	62	61	....	....	....	73	68	62	68	67	64	61	61	60	....	....	....	73	70	64	68	68	63
22	64	64	62	70	68	64	82	72	63	70	70	66	64	62	62	70	64	62	82	73	65	69	70	64
Mean,..	58 1/2	59 3/8	60 1/4	60 1/4	55 6/8	53 3/8	61 1/4	58 1/8	54 1/8	55	55	54 1/2	56 1/4	57 1/4	58 2/8	59 1/8	53 7/8	51 3/8	62 1/8	88 7/8	53 1/8	54 1/8	55	53 1/8
Highest	64	64	62	78	68	64	82	72	65	70	70	66	64	62	62	74	68	62	83	75	65	69	70	64
Lowest,	53	55	57	56	58	58	56	58	58	55	57	58	50	53	56	55	55	56	53	55	57	52	53	56

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.						3 o'clock p. m.						7 o'clock p. m.					
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	
15	48	48	48	....	....	W.	52	52	52	....	W.		52	52	52	....	W.		51	51	51	....	W.	
16	53	53	53	....	....	W.	66	67	66	....	S. W.		....	....	....	....	.....		60	59	59	....	W.	
17	54	53	53	52	....	N.	70	72	72	....	N. E.		72	73	74	....	N. E.		....	....	....	....	.....	
18	54	52	53	50	....	N.	74	74	73	....	S. E.		76	78	76	....	S.		67	66	66	....	S.	
19	61	60	60	....	61	S.	62	61	61	....	S.		63	62	62	57	S. E.		60	59	59	....	S. E.	
20	62	61	61	....	62	S. E.	66	66	66	....	S. E.		66	66	66	....	S. E.		66	65	65	....	S. E.	
21	62	62	62	....	61	W.	....	....	....	73	W.		66	66	66	73	S.		67	67	67	....	S.	
22	64	64	64	....	....	S.	71	71	71	....	S.		73	76	75	....	S.		66	66	66	....	N. E.	
Mean, ...	57 1/2	59 3/8	56 5/8	....	....	.....	57 5/8	57 3/8	57 3/8	....	.....		58 1/8	56 1/8	58 5/8	....	.....		54 6/8	54 1/8	54 1/8	....	.....	
Highest, ...	64	64	64	....	....	.....	74	74	73	....	.....		76	78	76	....	.....		67	67	67	....	.....	
Lowest, ...	48	48	48	....	....	.....	52	52	52	....	.....		52	52	52	....	.....		51	51	51	....	.....	

Observations.—15. Cloudy. Strong W. wind. Cool. 16. Morning few clouds. Strong W. breeze. Afternoon clear. Moderate breeze. 17. Morning clear. Light dew. Afternoon few clouds. Moderate breeze. 18. Morning clear. Afternoon few clouds. Light dew. Slight breeze. 19. Cloudy. Showery. Strong wind. 20. Cloudy. Showery. Strong breeze. 21. Cloudy. Showery. Thunder shower at 12 m. 22. Floating clouds. Soil very wet. Warm.

JUNE.

OBSERVATIONS ON SOIL OF GRASS LAND.

DAY OF MONTH.	5 o'clock a.m.	12 o'clock m.	3 o'clock p.m.	7 o'clock p.m.	5 o'clock a.m.	12 o'clock m.	3 o'clock p.m.	7 o'clock p.m.
	Surface.	Surface.	Surface.	Surface.	Surface.	Surface.	Surface.	Surface.
	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.
	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.
23	64 64 64	74 69 65	82 74 67	72 72 66	62 60 60	71 64 64	86 72 66	66 66 66
24	62 64 64	81 68 66	84 76 72	72 68 68	60 62 62	64 64 64	72 68 68	66 66 66
25	64 63 66	84 74 68	85 76 70	76 74 69	62 64 64	66 66 66	72 68 68	66 66 66
26	69 69 68	82 71 68	78 75 71	72 70 68	68 66 66	68 68 68	72 68 68	66 66 66
27	68 68 66	78 70 68	86 78 72	74 74 70	66 66 66	68 68 68	72 68 68	66 66 66
28	67 68 68	87 76 71	93 80 74	76 76 72	67 68 68	68 68 68	72 68 68	66 66 66
29	69 70 69	68 68 68	67 68 68	66 66 67	68 68 68	68 68 68	72 68 68	66 66 66
30	64 66 67	72 70 68	84 74 68	68 68 70	68 61 61	68 68 68	72 68 68	66 66 66
Mean,	65⅞ 66¼ 66¼	78 70¾ 67⅞	82⅜ 75¼ 69⅛	72 72 68⅜	64⅜ 63 62	71 66 65	86 76 67	66 66 66
Highest	69 70 69	87 76 71	93 80 74	76 76 72	68 68 68	72 68 68	72 68 68	66 66 66
Lowest,	44 63 64	68 68 68	67 68 68	66 66 67	44⅜ 60 62	64 64 64	72 68 68	66 66 66

OBSERVATIONS ON NAKED SOIL.

DAY OF MONTH.	5 o'clock a.m.	12 o'clock m.	3 o'clock p.m.	7 o'clock p.m.	5 o'clock a.m.	12 o'clock m.	3 o'clock p.m.	7 o'clock p.m.
	Surface.	Surface.	Surface.	Surface.	Surface.	Surface.	Surface.	Surface.
	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.	4 inches below surface.
	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.	9 inches below surface.
23	62 62 62	71 63 63	86 64 64	64 72 72	62 62 62	71 64 64	86 72 66	66 66 66
24	62 62 62	81 66 66	85 73 69	72 72 72	62 62 62	64 64 64	72 68 68	66 66 66
25	64 64 64	85 73 69	97 89 84	76 76 76	64 64 64	66 66 66	72 68 68	66 66 66
26	64 64 64	83 72 69	89 84 80	76 76 76	64 64 64	68 68 68	72 68 68	66 66 66
27	64 64 64	86 74 69	97 94 88	84 84 84	64 64 64	68 68 68	72 68 68	66 66 66
28	64 64 64	88 74 69	97 94 88	84 84 84	64 64 64	68 68 68	72 68 68	66 66 66
29	64 64 64	88 74 69	97 94 88	84 84 84	64 64 64	68 68 68	72 68 68	66 66 66
30	64 64 64	88 74 69	97 94 88	84 84 84	64 64 64	68 68 68	72 68 68	66 66 66
Mean,	63 63 63	83 72 69	93 86 81	78 79 78	63 63 63	69 67 67	78 71 68	68 68 68
Highest	64 64 64	88 74 69	97 94 88	84 84 84	64 64 64	71 72 72	86 76 72	68 68 68
Lowest,	62 62 62	71 63 63	86 64 64	64 72 72	62 62 62	64 64 64	72 68 68	66 66 66

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.	12 o'clock m.	3 o'clock p. m.	7 o'clock p. m.
	Air, 4 feet above surface.	Air, 4 feet above surface.	Air, 4 feet above surface.	Air, 4 feet above surface.
	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, naked soil.
	Air, 4 inches above surface, grass land.	Air, 4 inches above surface, grass land.	Air, 4 inches above surface, grass land.	Air, 4 inches above surface, grass land.
	Dew.	Rain.	Rain.	Rain.
	Rain.	Wind.	Wind.	Wind.
	Wind.			
23	62 62 62 .... N.	71 77 84 .... N. E.	76 82 83 .... S. W.	70 73 78 .... W.
24	63 64 64 .... N. E.	77 84 84 .... N.	83 84 84 .... S. W.	73 78 79 .... W.
25	64 63 63 .... N.	84 84 82 .... S. W.	76 75 75 .... S. W.	78 74 74 .... S.
26	70 69 69 .... S. W.	84 82 82 .... W.	86 84 86 .... W.	77 75 73 .... W.
27	72 70 70 .... W.	82 80 80 .... N.	87 86 87 .... W.	78 75 74 .... S. W.
28	68 68 68 .... N.	84 84 84 .... N.	86 86 86 .... W.	77 75 75 .... S. W.
29	68 68 67 .... N.	84 84 84 .... N.	86 86 86 .... W.	76 75 75 .... S. W.
30	60 61 61 .... N. W.	74 66 74 .... N. W.	76 78 76 .... N.	69 69 69 .... N.
Mean,	65⅛ 65⅛ 65⅛	77⅜ 77¼ 77¼	78⅛ 78¼ 78⅛	73¼ 74¼ 74¼ ....
Highest,	72 70 70	84 84 84	86 86 86	78 77 77 ....
Lowest,	60 61 61	66 66 66	66 66 66	65 65 65 ....

JULY.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a.m			12 o'clock m.			3 o'clock p.m			7 o'clock p m			5 o'clock a.m			12 o'clock m			3 o'clock p.m			7 o'clock p.m		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
16	65	68	70	88	66	72	87	77	73	77	76	73	62	67	69	100	84	73	97	84	73	78	82	73
17	69	71	72	90	78	73	90	80	75	81	79	75	67	70	71	104	82	74	99	88	76	84	82	76
18	73	74	73	90	77	74	86	80	75	81	80	76	73	74	73	97	78	74	90	84	75	82	80	76
19	74	75	74	99	82	76	86	84	77	82	80	77	72	74	74	106	86	76	86	94	77	80	82	77
20	75	76	76	102	88	77	84	86	79	76	83	79	74	75	75	106	92	77	86	86	79	76	82	79
21	74	75	75	80	75	75	76	76	75	75	75	75	73	74	74	80	76	74	76	76	74	74	74	74
22	73	74	74	81	78	75	80	78	76	76	76	75	73	72	72	85	81	74	78	78	75	74	76	74
23	69	71	73	92	79	75	92	82	76	76	78	76	65	68	72	104	81	74	102	84	75	76	80	75
Mean,..	71½	73	73⅜	90⅜	78⅞	74⅛	85⅛	80⅜	75⅜	78	78⅛	75⅜	69⅞	71⅜	72⅛	97⅜	83⅛	74⅛	89⅛	84⅛	75⅛	78	79⅛	75⅛
Highest	75	76	76	102	88	77	92	86	79	82	83	79	74	75	75	106	92	77	102	94	79	84	82	79
Lowest,	65	68	70	80	66	72½	76	76	75	75	75	73	62	67	69	80	76	73	76	76	73	74	74	73

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
16	62	60	60	59	....	N.E.	81	83	82	....	S.	83	84	83	....	S.	77	76	74	....	S.
17	67	67	60	....	....	S.E.	84	88	87	....	S.E	86	87	86	....	S.	80	80	79	....	S.
18	72	72	72	....	78	S.	84	87	86	....	S.	81	82	81	....	S.W.	80	80	79	....	S.
19	75	74	74	....	72	S.	89	92	91	....	S.	81	81	79	79	S.	84	84	84	....	S.E.
20	76	76	75	....	....	S.E.	90	96	95	....	S.	76	77	76	77	S.	75	75	75	75	S.
21	72	72	72	....	70	S.	78	78	78	70	S.	74	74	74	70	S.	74	74	74	....	S.
22	75	75	75	....	....	S.	82	82	82	....	S.	77	78	77	74	S.	73	73	73	....	S.
23	66	66	66	....	....	N.	80	84	83	....	W.	81	84	83	....	N.	73	73	73	....	N.
Mean,.....	70⅝	70⅛	49½	....	....	.....	83¼	86⅛	85⅛	....	.....	79⅝	80¼	79⅞	....	.....	77	76⅞	76⅜	....	.....
Highest, ..	76	76	75	....	....	.....	90	96	95	....	.....	86	87	86	....	.....	84	84	84	....	.....
Lowest,...	62	60	60	....	....	.....	78	78	78	....	.....	74	74	74	....	.....	73	73	73	....	.....

Observations.—16. Clear. Smoky. Light breeze. 17. Few heavy clouds. Strong breeze. 18. Morning, few heavy clouds. Afternoon cloudy. Thunder shower. 19. Morning few hazy clouds. Afternoon cloudy. Showery. Soil wet 1¼ inches deep. 20. Morning, floating clouds. Thunder shower between 2 and 3 p. m. 7 p. m. showery. 21. Cloudy. Showery. Soil wet ¾ inches deep. Strong breeze. 22. Morning, thick clouds, strong S. breeze. Afternoon showery. 23. Few clouds. Smoky, north breeze. Warm.

JULY.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.			5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
8	68	69	69	90	73	70	82	76	70	77	76	70	65	68	68	94	77	69	105	76	70	84	76	70
9	69	70	70	89	78	71	84	78	72	78	76	72	69	69	69	104	82	71	94	98	72	81	80	73
10	70	72	72	86	75	73	94	80	75	82	76	75	68	72	71	91	76	73	104	92	76	86	86	76
11	74	74	73	96	78	76	89	80	76	81	79	76	74	74	73	103	85	77	100	86	77	85	85	77
12	75	74	73	92	78	76	90	79	76	78	78	76	76	75	74	98	84	77	100	86	77	80	84	77
13	70	72	72	90	80	76	78	76	73	74	76	73	69	71	72	100	84	76	78	76	73	74	75	73
14	64	69	70	90	77	71	86	79	74	73	76	72	64	67	69	91	80	71	92	84	74	72	76	72
15	63	68	70	90	75	71	81	78	72	73	76	72	58	65	69	96	78	72	88	82	74	73	76	72
Mean,..	69½	71	71½	91⅜	76⅞	73	85½	78¼	73½	77	76⅝	73½	68	70⅛	70⅝	97⅛	80¼	73½	94	85	74¼	69⅝	79⅜	73⅜
Highest	75	74	73	96	80	76	94	80	76	82	79	76	76	75	77	104	85	77	105	98	77	86	86	77
Lowest,	63	68	69	86	73	70	78	76	70	73	76	70	58	65	68	91	76	69	78	76	70	72	75	70

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
8	67	65	64	64	....	N.	87	89	88	....	S.	89	90	87	....	S. E.	84	83	80	....	S.
9	69	69	68	67	....	N.	88	90	88	....	S.	88	88	87	....	S.	81	80	78	....	S. E.
10	68	66	66	66	....	S. E.	82	83	82	....	S. E.	86	88	88	....	S.	78	78	77	....	S.
11	73	74	74	....	....	E.	85	89	87	....	S.	84	84	82	....	S. E.	80	80	79	....	S. E.
12	74	74	74	....	....	S.	83	89	88	....	E.	84	86	86	....	S.	74	74	73	....	W.
13	69	69	69	....	69	W.	83	87	87	....	N. W.	74	73	73	73	N. W.	74	74	74	73	N.
14	64	64	64	....	65	N.	76	77	76	....	N.	76	78	78	....	N.	70	70	69	....	N.
15	57	57	57	55	....	N.	77	80	79	....	E.	76	78	77	....	S. W.	70	69	67	....	N.
Mean, ...	67⅝	67¼	68¼	....	....	.....	82⅝	85½	84	....	.....	82⅛	83⅛	82¼	....	.....	76¼	76	69⅜	....	.....
Highest, ...	74	74	74	....	....	.....	88	90	88	....	.....	89	90	88	....	.....	84	83	80	....	.....
Lowest, ...	57	57	57	....	....	.....	76	77	76	....	.....	74	73	73	....	.....	70	69	67	....	.....

OBSERVATIONS.—8. Clear. Smoky. Slight dew. Moderate breeze. 9. Morning clear. Light dew. Afternoon few hazy clouds. Smoky. Light breeze. 10. Light dew. Few hazy clouds. Smoky. Light breeze. 11. Morning floating clouds. Light breeze. Warm 7 p. m. Cloudy. Stiff S. E. breeze. 12. Forenoon moderately cloudy. Slight breeze. Warm. 7 p. m. cloudy. Signs of rain. 13. Cloudy. Shower last night. Wet soil 1 inch deep. Heavy thunder shower between 1 and 2 p. m. Wet soil 8 inches deep. Moderate breeze. 14. Clear N. breeze. Soil wet from 8 to 10 inches deep. Shower during night. Few hazy clouds. Light dew. Moderate breeze. Smoky.

JULY.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a.m			12 o'clock m.			3 o'clock p.m			7 o'clock p m			5 o'clock a.m			12 o'clock m			3 o'clock p.m			7 o'clock p.m		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
16	65	68	70	88	66	72	87	77	73	77	76	73	62	67	69	100	84	73	97	84	73	78	82	73
17	69	71	72	90	78	73	90	80	75	81	79	75	67	70	71	104	82	74	99	88	76	84	82	76
18	73	74	73	90	77	74	86	80	75	81	80	76	73	74	73	97	78	74	90	84	75	82	80	76
19	74	75	74	99	82	76	86	84	77	82	80	77	72	74	74	106	86	76	86	94	77	80	82	77
20	75	76	76	102	88	77	84	86	79	76	83	79	74	75	75	106	92	77	86	86	79	76	82	79
21	74	75	75	80	75	75	76	76	75	75	75	75	73	74	74	80	76	74	76	76	74	74	74	74
22	73	74	74	81	78	75	80	78	76	76	76	75	73	72	72	85	81	74	78	78	75	74	76	74
23	69	71	73	92	79	75	92	82	76	76	78	76	65	68	72	104	81	74	102	84	75	76	80	75
Mean,..	71 1/2	73	73 3/8	90 5/8	78 7/8	74 1/4	85 1/2	80 1/2	75 3/8	78	78 3/8	75 3/8	69 7/8	71 3/8	72 1/4	97 3/8	83 5/8	74 1/4	89 1/4	84 1/4	75 1/4	78	79 1/4	75 1/4
Highest	75	76	76	102	88	77	92	86	79	82	83	79	74	75	75	106	92	77	102	94	79	84	82	79
Lowest,	65	68	70	83	66	72 1/4	76	76	75	75	75	73	62	67	69	80	76	73	76	76	73	74	74	73

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
16	62	60	60	59	....	N.E.	81	83	82	....	S.	83	84	83	....	S.	77	76	74	....	S.
17	67	67	60	....	....	S.E.	84	88	87	....	S.E	86	87	86	....	S.	80	80	79	....	S.
18	72	72	72	....	78	S.	84	87	86	....	S.	81	82	81	....	S.W.	80	80	79	....	S.
19	75	74	74	....	72	S.	89	92	91	....	S.	81	81	79	79	S.	84	84	84	....	S.E.
20	76	76	75	....	....	S.E.	90	96	95	....	S.	76	77	76	77	S.	75	75	75	75	S.
21	72	72	72	....	70	S.	78	78	78	70	S.	74	74	74	70	S.	74	74	74	....	S.
22	75	75	75	....	....	S.	82	82	82	....	S.	77	78	77	74	S.	73	73	73	....	S.
23	66	66	66	....	....	N.	80	84	83	....	W.	81	84	83	....	N.	73	73	73	....	N.
Mean,.....	70 5/8	70 1/4	49 1/8	....	....	.....	83 1/4	86 1/4	85 1/4	....	.....	79 5/8	80 1/4	79 7/8	....	.....	77	76 7/8	76 3/8	....	.....
Highest, ..	76	76	75	....	....	.....	90	96	95	....	.....	86	87	86	....	.....	84	84	84	....	.....
Lowest,...	62	60	60	....	....	.....	78	78	78	....	.....	74	74	74	....	.....	73	73	73	....	.....

OBSERVATIONS.—16. Clear. Smoky. Light breeze. 17. Few heavy clouds. Strong breeze. 18. Morning, few heavy clouds. Afternoon cloudy. Thunder shower. 19. Morning few hazy clouds. Afternoon cloudy. Showery. Soil wet 1 1/2 inches deep. 20. Morning, floating clouds. Thunder shower between 2 and 3 p. m. 7 p. m. showery. 21. Cloudy. Showery. Soil wet 3/4 inches deep. Strong breeze. 22. Morning, thick clouds, strong S. breeze. Afternoon showery. 23. Few clouds. Smoky, north breeze. Warm.

JULY.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.			5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.		
	Surface.	4 inches below the surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
24	68	71	72	94	78	74	88	83	76	80	78	76	66	70	72	106	80	74	96	85	77	82	80	77
25	72	74	74	80	75	74	80	76	74	76	76	74	72	73	74	83	76	74	82	77	74	76	76	74
26	74	73	73	74	73	73	69	73	74	64	71	72	74	72	72	74	74	73	69	72	73	64	70	72
27	62	66	68	68	72	68	84	75	73	66	73	73	56	62	67	90	73	68	92	78	73	65	72	72
28	59	66	68	82	70	69	87	77	72	63	70	71	56	63	68	93	71	69	92	80	72	64	72	73
29	59	62	66	84	76	70	82	77	72	72	76	73	57	64	68	92	80	71	88	81	73	74	76	74
30	62	64	68	80	73	70	70	72	70	68	71	70	61	63	68	82	75	71	70	73	71	68	72	71
31	68	66	68	82	72	68	86	77	69	82	77	69	68	66	68	85	75	69	88	80	70	82	78	70
Mean, .	65 1/4	67 1/2	69 5/8	80 1/4	73 3/8	70 7/8	80 1/2	76 1/4	72 1/4	71 3/8	74	72 1/4	63 1/2	66 3/8	69 1/8	88 1/4	75 1/4	71 1/4	84 5/8	78 1/4	73	72	74 1/4	73
Highest	74	74	74	94	78	74	88	83	76	82	78	76	74	73	74	106	80	74	96	85	77	82	80	77
Lowest,	59	62	66	68	70	68	69	72	69	63	70	69	56	62	67	74	71	68	69	72	70	64	70	70

DAY OF MONTH.	OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.																							
	5 o'clock a. m.							12 o'clock m.						3 o'clock p. m.						7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
24	66	66	66	62	....	N.		83	87	86	....	S.		84	87	86	....	S.		80	78	78	....	S.
25	72	72	71	....	....	S.		78	78	78	....	S.		79	79	78	....	S.		76	76	75	....	S.
26	75	75	75	....	....	S.		68	68	68	66	N.W		65	65	65	62	N.		62	62	62	....	N.
27	57	57	57	....	73	N.		68	70	68	....	N.W		69	72	70	....	N.		63	62	61	73	N.
28	56	56	56	....	....	N.W		72	74	73	....	N.W		72	74	73	....	N.		64	62	64	....	N.
29	58	58	55	53	....	S. E.		73	70	75	....	S. W		73	76	75	....	S.		69	69	68	....	S.
30	68	68	68	....	....	S.		72	74	73	....	S.		66	66	66	64	S. E.		65	65	65	64	S.
31	69	69	69	....	67	S.		75	76	75	....	S.		78	81	60	....	E.		74	74	74	....	S.
Mean,.....	65 1/4	65 1/4	64 5/8	....	....	....		73 5/8	75	74 1/4	....	....		70 3/4	75	74 1/4	....	....		69 1/4	68 1/4	68 1/8	....	....
Highest, ...	75	75	75	....	....	....		83	87	86	....	....		84	87	86	....	....		80	78	78	....	....
Lowest, ...	56	56	55	....	....	....		68	68	68	....	....		65	65	65	....	....		62	62	61	....	....

OBSERVATIONS.—24. Morning clear. Light dew. Afternoon few clouds. Moderate breeze. 25. Forenoon cloudy, Strong south breeze. Afternoon slight showers. 26. Cloudy, showery, moderate breeze. 27. Few clouds, moderate breeze, cool morning. 28. Few heavy clouds. Morning cool. Moderate breeze. 29. Morning clear. Heavy dew. Cool. Afternoon cloudy, showery. Moderate breeze. 30. Morning cloudy, showery. Soil wet 12—14 inches deep.

Afternoon few clou..

AUGUST.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a m			12 o'clock m			3 o'clock a m			7 o'clock p m			5 o'clock p m			12 o'clock m.			3 o'clock p.m			7 o'clock p m		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
1	72	70	70	86	76	72	87	76	72	74	75	72	72	70	70	86	76	72	88	77	72	74	75	72
2	67	67	70	86	77	72	82	77	72	72	74	72	64	66	69	87	78	72	86	79	72	70	74	72
3	68	69	70	86	74	71	82	76	72	73	75	72	60	67	68	88	76	70	82	78	73	72	74	73
4	66	68	70	90	77	72	86	79	73	74	76	73	64	67	69	92	80	73	88	81	74	74	76	74
5	68	69	70	86	75	71	83	76	73	74	75	73	65	68	70	90	77	72	84	78	74	73	75	74
6	67	68	70	84	75	72	79	76	73	75	76	73	63	67	70	88	77	73	82	78	84	76	77	74
7	69	70	71	69	70	71	69	70	71	69	70	71	68	69	70	68	69	70	68	69	70	68	69	70
Mean,..	68	68¼	70	84	75	71⅛	81	75½	72	73	74	72	63⅛	69	69	85	76	72	82½	77	74	72½	74	72½
Highest	72	70	71	90	77	72	87	72	73	74	76	73	72	70	70	92	80	73	88	81	84	72	75	74
Lowest,	66	67	71	69	70	71	69	70	71	69	74	71	64	66	68	68	89	70	68	69	72	68	69	72

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
1	72	72	71	....	....	S.	80	82	81	....	S.	81	83	82	....	S.	74	74	74	....	S.E.
2	66	66	65	62	....	N.W.	76	80	76	....	W.	77	79	78	....	W.	69	68	68	....	W.
3	65	65	65	62	....	W.	76	78	78	....	E.	76	77	77	....	E.	72	70	70	....	S.
4	65	65	64	62	....	N.E.	80	82	81	....	N.E.	80	82	81	....	N.E.	72	70	70	....	S.E.
5	64	64	64	62	....	N.E.	78	82	81	....	N.E.	80	81	80	....	N.E.	72	70	70	....	S.E.
6	64	64	64	....	....	N.W.	78	80	79	....	N.W.	77	77	76	....	N.W.	74	74	74	....	S.
7	67	67	66	....	....	N.	68	68	68	66	N.E.	68	68	68	68	N.E.	67	67	67	67	N.E.
Mean, ...	67	67	66	62	....	.....	76	79	77½	....	.....	77	78	77	....	.....	71	62	52	....	.....
Highest, ...	72	72	71	....	....	.....	80	82	81	....	.....	81	83	82	....	.....	74	74	74	....	.....
Lowest,....	64	64	64	....	....	.....	68	68	68	....	.....	68	68	68	....	.....	67	67	67	....	.....

OBSERVATIONS.—Floating clouds. Slight sprinkling between 7 and 8 a. m. 2. Few floating clouds. Moderate dew. 3. Few heavy clouds near the horizon. Heavy dew. 4. Few floating clouds. Heavy dews. 5. During forenoon few heavy clouds. Afternoon thick clouds. Moderate dew. 6. Cloudy in morning, heavy thin clouds at noon. Thick floating clouds at night. 7. Cloudy. Slight sprinkling of rain in morning. Afternoon stormy.

AUGUST.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a.m			12 oclock m.			3 o'clock p.m			7 o'clock p.m			5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
8	68	68	69	75	72	70	74	72	70	72	72	70	68	67	68	75	72	70	74	72	70	72	72	70
9	69	69	70	78	72	70	76	72	71	75	72	71	69	69	69	79	74	70	77	74	72	76	74	72
10	72	72	71	89	76	72	84	78	74	78	77	74	72	71	70	90	80	73	85	82	75	78	78	75
11	74	74	73	92	81	74	93	82	76	78	80	76	74	74	73	94	85	74	96	84	76	78	80	76
12	72	73	74	86	78	74	86	82	76	75	78	76	72	72	73	88	79	74	90	84	76	74	78	76
13	71	73	74	87	78	74	86	82	76	76	78	76	69	70	73	92	80	74	90	84	77	78	79	76
14	72	72	73	87	78	75	86	79	75	73	77	75	70	72	73	89	80	75	88	83	76	78	78	76
15	72	73	74	87	80	75	88	83	76	76	78	76	70	72	73	92	81	75	93	86	77	76	78	76
Mean,	71¼	71⅜	72⅛	85⅛	76⅞	71¾	84⅛	78⅝	74¼	76⅝	76½	74⅛	70	80⅞	71⅛	87⅜	78⅞	73⅛	81⅝	81⅛	75	76¼	77⅛	74⅛
Highest	74	74	74	92	81	75	93	83	76	78	80	76	74	74	73	94	85	75	96	86	77	78	80	76
Lowest,	68	68	69	75	72	70	74	72	70	72	72	70	68	67	68	75	72	70	74	72	70	72	72	70

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.					12 o'clock m.				3 o'clock p. m.				7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
8	67	67	67	....	67	N.E.	73	74	73	....	W.	73	73	73	....	N.E.	72	72	72	....	N.E.
9	73	73	73	....	....	N.E.	78	78	78	....	E.	77	77	76	....	S.E.	75	73	75	....	S.E.
10	73	73	73	....	....	S.E.	84	82	82	....	S.	85	85	84	....	S.	77	78	77	....	S.
11	74	74	73	....	....	S.	85	84	84	....	N.E.	82	82	81	....	W.	74	72	72	....	W.
12	72	72	72	....	....	W.	80	81	81	....	N.E.	81	81	81	....	W.	74	74	74	....	N.E.
13	70	69	69	66	....	W.	82	84	83	....	S.	82	84	83	....	S.	76	75	74	....	S.
14	68	68	68	....	....	N.W.	83	86	85	....	S.	82	86	85	....	S. E.	75	75	74	....	S. E.
15	70	70	70	....	....	S.	82	86	85	....	S.	81	86	85	....	S. E.	75	75	74	....	S. E.
Mean,	70¼	70⅛	70⅛	....	....	.....	80⅞	82⅜	81⅛	....	.....	81	82⅝	81⅜	....	.....	74⅛	74⅜	73⅞	....	.....
Highest,	75	75	74	....	....	.....	89	88	87	....	.....	87	89	88	....	.....	78	78	77	....	.....
Lowest,	67	67	67	....	....	.....	73	74	73	....	.....	73	73	73	....	.....	72	72	72	....	.....

OBSERVATIONS.—8. Cloudy. Moderate breeze. 9. Cloudy. Moderate breeze. 10. Few thick floating clouds. Stiff south breeze in afternoon. 11. Few thin clouds in the forenoon. Clouds increased in the afternoon. Light shower at 5 o'clock p. m. Light breeze. 12. Few thin clouds, moderate breeze. Pleasant. 13. Heavy dew. Clear. ight breeze. 14. Few heavy clouds. Light breeze. 15. Few heavy clouds. Light breeze.

AUGUST.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a m			12 o'clock m			3 o'clock p m			7 o'clock p m			5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
16	70	72	74	82	76	74	81	76	74	73	76	76	68	71	73	86	76	74	82	76	74	75	78	76
17	72	73	74	82	76	74	85	77	75	76	76	75	72	73	73	82	77	74	87	80	75	77	76	76
18	69	72	73	76	74	73	75	75	73	69	73	73	69	72	72	78	75	73	76	76	74	67	73	74
19	62	67	70	74	71	70	72	70	70	65	69	69	62	67	69	75	72	70	71	70	70	64	68	68
20	60	63	68	74	70	69	74	73	70	68	72	70	60	63	67	81	72	69	77	75	70	68	72	70
21	64	64	69	67	72	70	76	74	72	77	72	71	64	64	68	81	74	69	79	76	72	72	73	71
22	62	63	69	78	72	69	79	74	70	76	72	71	62	63	68	78	73	69	78	75	71	71	72	71
23	61	63	68	74	71	69	....	....	....	....	....	....	61	62	67	77	73	69	....	....	....	....	....	....
24	60	63	67	80	72	69	80	74	70	....	....	....	60	62	66	81	74	69	81	77	77	....	....	....
25	62	64	68	....	....	....	....	....	....	....	....	....	62	64	67	....	....	....	....	....	....	....	....	....
Mean,	64½	66⅔	70	76⅔	72⅝	70⅔	77½	74⅛	71⅓	72	72⅞	72⅛	64	67⅛	69	79⅞	74	70⅝	78⅞	75⅝	72⅛	70½	73⅛	73¼
Highest,	72	73	74	82	76	74	85	77	75	77	76	76	72	73	73	86	77	74	87	80	75	77	78	76
Lowest.	60	63	67	67	70	69	72	70	70	68	69	69	60	62	66	75	72	69	71	70	70	64	68	68

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air 4 feet above surface.	Air 4 inches above surface, naked soil.	Air 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
16	66	66	68	....	....	S.	81	82	80	....	S.	80	82	81	....	S.	74	74	73	....	S.
17	71	71	70	....	....	S.	81	82	80	....	S.	85	87	85	....	S.	76	76	75	....	S.
18	69	69	69	....	69	S.	73	73	73	....	W.	74	84	74	....	N.W.	65	65	65	....	W.
19	62	62	62	....	56	W.	69	69	69	....	W.	67	67	67	....	W.	62	62	62	....	W.
20	60	60	60	56	....	S.	70	70	70	....	S.W.	72	71	71	....	.SW.	66	66	66	....	S.W.
21	64	64	64	60	....	S.	76	76	76	....	S.W.	76	77	76	....	S.W.	70	70	69	....	N.W.
22	62	62	62	57	....	S.	75	75	75	....	S.	73	74	74	....	S.	70	70	70	....	S.
23	60	60	58	55	....	N.	70	72	70	....	N.W.	....	....	....	....	.....	....	....	....	....	.....
24	59	59	58	56	....	N.	74	76	74	....	N.	73	76	74	....	N.	....	....	....	....	.....
25	62	62	62	59	....	N.	....	....	....	....	.....	....	....	....	....	.....	....	....	....	....	.....
Mean, ...	63½	63½	63½	....	....	.....	74⅛	75	74½	....	.....	75	76	75¼	....	.....	69	69	68¼	....	.....
Highest, ...	71	71	70	....	....	.....	80	82	81	....	.....	85	87	85	....	.....	76	76	75	....	.....
Lowest, ...	59	59	58	....	....	.....	69	69	69	....	.....	67	67	67	....	.....	62	62	62	....	.....

OBSERVATIONS.—16. Morning cloudy. Middle of day few hazy clouds. At 7 p. m. cloudy, moderate breeze. 17. Morning cloudy, rest of day few hazy clouds. Moderate breeze. 18. Thunder shower during night. Thick floating clouds, stiff breeze. 19. Morning cloudy, light shower. Middle of day, few clouds. 7 p. m. clear, moderate breeze. 20. Forepart of day few clouds. At 4 p. m. a moderate shower. Light breeze, heavy dew. 21. Few clouds. Moderate breeze, light dew. 22. Few clouds, light breeze, moderate dew. 23. Morning clear, heavy dew. In afternoon few clouds, moderate breeze. 24. Morning clear, heavy dew. Afternoon few clouds, light breeze. 25. Clear north breeze. From the 25th to the 31st the weather was very moderate, about like the 20th, 21st, 22d and 23d. Most of time clear. Moderate north breeze. No rain of any consequence. Moderate dews. Nights pleasant.

SEPTEMBER.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.			5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.		
	Surface.	4 inches below the surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
1	65	65	66	83	73	70	....	....	....	76	73	70	65	65	66	84	73	71	....	....	....	76	73	71
2	64	66	67	83	74	70	....	....	....	73	73	70	64	65	66	85	74	71	....	....	....	73	73	71
3	69	68	69	82	76	71	....	....	....	76	76	73	69	68	68	82	76	71	....	....	....	76	76	72
4	70	70	70	82	74	73	76	75	74	72	74	73	70	70	69	83	75	73	76	75	74	72	74	72
5	70	70	70	82	76	74	80	76	74	74	74	74	70	70	70	82	76	74	80	76	74	74	74	74
6	64	66	68	75	71	70	71	71	70	66	76	70	64	66	68	75	72	70	71	71	70	65	69	70
7	60	60	65	81	73	69	76	73	69	70	70	69	60	60	65	82	74	70	75	74	70	70	70	70
8	66	65	67	75	72	69	72	72	69	71	72	69	66	65	66	85	73	70	71	72	70	71	72	70
Mean,..	66	66¼	67⅞	80⅝	73⅞	70⅞	46⅞	45⅞	44¼	72¼	72⅜	71⅛	66	66¼	67⅜	82¼	74¼	71⅜	46⅜	46	44⅜	72⅛	72⅜	78½
Highest	70	70	70	83	76	74	80	76	74	76	76	74	70	70	70	85	76	74	80	76	74	76	76	74
Lowest,	60	60	66	75	71	69	72	71	69	66	70	70	60	60	65	75	72	70	71	71	70	70	70	70

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.					12 o'clock m.				3 o'clock p. m.				7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
1	65	65	65	....	....	N.	78	77	76	....	N.	....	....	....	....	.....	74	74	74	....	N.
2	64	64	64	....	....	N.W.	76	78	77	....	N.	....	....	....	....	.....	73	73	74	....	N.
3	70	70	70	....	....	S.	79	82	80	....	S.	....	....	....	....	.....	78	78	78	....	S.
4	71	71	70	....	....	N.	76	78	77	....	N.	76	76	76	....	N.	72	72	72	....	N.
5	74	74	74	....	....	S.	80	80	80	....	S.	80	80	80	....	S.	76	76	76	....	S.
6	66	66	66	....	....	N.	70	70	70	....	N.	71	71	71	....	N.	67	67	67	....	W.
7	61	61	61	....	....	N.	74	70	71	....	E.	71	75	71	....	E.	70	70	70	....	E.
8	61	61	61	....	....	S.	73	73	73	....	S.	71	71	71	....	S.	70	70	70	....	S.
Mean, ...	66⅛	66⅛	66⅛	.....	.....	.....	75⅞	77	75⅞	.....	.....	46⅛	46⅛	46⅛	.....	.....	72⅛	72⅛	72⅛	.....	.....
Highest, ..	74	74	74	.....	.....	.....	80	80	80	.....	.....	80	80	80	.....	.....	78	78	78	.....	.....
Lowest, ..	61	61	61	.....	.....	.....	70	70	70	.....	.....	71	71	71	.....	.....	70	70	70	.....	.....

OBSERVATIONS—1. Clear N. breeze. 2. Clear N. breeze. Smoky. 3. Morning cloudy. Afternoon clear. Moderate S. breeze. Warm. 4. Few hazy clouds. N. breeze. Smoky. 5. Thick floating clouds. Strong S. breeze. 6. Rained during night. Thick floating clouds. Moderate breeze. 7. Morning clear. Afternoon few clouds. Moderate breeze. 8. Cloudy. Moderate S. breeze.

SEPTEMBER.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a.m			12 o'clock m.			3 o'clock p m			7 o'clock p m			5 o'clock a.m			12 o'clock m			3 o'clock p.m			7 o'clock p.m		
	Surface.	4 Inches below surface.	9 Inches below surface.	Surface.	4 Inches below surface.	9 inches below surface.	Surface.	4 Inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 Inches below surface.	9 inches below surface.	Surface.	4 Inches below surface.	9 inches below surface.
9	73	70	70	74	73	70	70	72	70	65	69	70	73	70	70	75	74	70	70	72	70	65	69	70
10	61	63	65	67	68	67	67	68	67	62	64	66	61	62	64	67	68	66	67	60	66	62	64	65
11	60	60	63	69	66	64	68	61	66	64	64	66	60	60	62	69	66	64	66	66	65	64	64	65
12	62	62	64	66	66	64	67	66	65	65	64	65	62	62	64	67	66	64	67	66	65	65	64	65
13	54	63	65	73	70	65	71	70	65	66	66	67	64	63	64	73	70	65	70	70	65	66	66	66
14	59	61	63	62	63	64	59	60	62	56	59	61	59	61	63	62	63	64	59	60	62	56	59	61
15	52	53	59	68	63	62	60	60	61	55	58	60	52	53	58	69	63	62	60	60	61	55	58	60
16	48	51	59	69	65	61	70	67	63	58	60	63	48	51	58	70	65	62	71	68	64	58	60	63
Mean,	58⅝	60⅜	64	68½	66⅞	64⅞	66½	65½	64⅝	61⅛	63	64⅝	59⅞	60½	62⅞	69	66¾	64⅛	66¼	66¼	64⅜	61⅜	63	64⅜
Highest	73	70	70	74	73	70	71	72	70	66	69	70	73	70	70	75	74	70	71	72	70	66	69	70
Lowest,	48	51	59	62	63	61	59	60	61	55	58	60	48	51	58	62	63	62	60	60	61	55	58	60

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.						3 o'clock p. m.						7 o'clock p. m.					
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	
9	76	76	76	....	....	S.	70	70	70	....	S.W.		65	65	65	65	S.W.		62	62	62	64	N.	
10	62	62	62	....	....	N.	66	66	66	....	N.		66	66	66	....	N.		64	64	64	....	N.	
11	60	60	60	....	....	N.	68	68	68	....	N.		68	68	68	....	N.		64	64	64	60	N.	
12	62	62	62	....	....	N.	66	66	66	....	N.		67	67	67	....	N.		65	65	65	....	N.	
13	64	64	64	....	....	N.	70	70	70	....	N.		68	68	68	64	N.		66	66	66	....	N.	
14	58	58	58	....	....	W.	61	61	61	....	W.		60	60	60	....	W.		54	54	54	....	W.	
15	52	52	52	46	....	N.	60	60	60	....	W.		62	62	62	....	W.		57	57	57	....	W.	
16	49	49	49	44	....	S.	66	66	66	....	N.W.		67	67	67	....	N.W.		60	60	60	....	N.W.	
Mean, ...	60⅛	60⅜	60⅜	....	....	.....	65⅞	65⅝	65⅞	....	.....		65⅜	65⅜	65⅜	....	.....		61½	68¼	61½	....	.....	
Highest, ...	76	76	76	....	....	.....	70	70	70	....	.....		68	68	68	....	.....		66	66	66	....	.....	
Lowest, ...	49	49	49	....	....	.....	60	60	60	....	.....		60	60	60	....	.....		54	54	54	....	.....	

SEPTEMBER.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.			5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.		
	Surface.	4 inches below the surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
17	50	51	57	80	63	61	70	66	61	61	61	62	50	51	57	82	64	62	71	66	62	61	61	62
18	56	57	61	70	61	62	68	67	64	62	65	64	56	57	60	71	62	62	68	67	64	62	64	64
19	60	59	61	62	62	62	61	61	60	62	62	62	60	58	60	65	63	62	62	61	60	62	62	62
20	54	56	59	68	64	62	65	62	62	62	62	62	54	56	58	69	65	62	65	62	62	62	62	62
21	59	58	60	71	66	62	72	66	62	62	63	62	59	58	60	72	66	62	72	65	62	62	63	62
22	52	64	59	79	66	64	79	70	65	62	65	64	52	54	58	81	67	64	81	71	65	61	64	63
23	52	53	58	74	70	63	66	65	64	62	63	63	52	53	58	80	71	63	66	64	64	62	63	63
Mean,	54⅞	55⅜	59⅛	72	64⅝	62⅛	68⅜	65¼	62⅜	61⅝	63	62⅜	54⅞	55¼	58⅜	74¼	65¾	62⅜	69¼	65¼	65⅛	61⅝	62⅜	62⅜
Highest	60	59	61	80	70	64	79	70	65	62	65	64	60	58	58	82	71	64	81	71	65	62	64	64
Lowest	50	51	57	62	61	61	61	61	60	61	61	62	52	51	57	65	62	62	62	61	60	61	61	62

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.						3 o'clock p. m.						7 o'clock p. m.					
	Air, 1 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 1 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 1 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	
17	50	50	50	45	....	N.	67	67	67	....	N E		69	69	69	....	W.		64	64	63	....	S.	
18	58	58	57	56	....	N.	68	68	67	....	N.		68	68	68	....	S.		66	66	65	....	S E	
19	62	62	62	....	....	S. E.	64	64	62	....	N E		62	62	61	....	S E		63	63	62	....	S E	
20	57	57	57	....	....	N. E.	64	64	64	....	N.		63	63	63	....	N.		62	62	62	....	N.	
21	62	62	62	....	....	W.	68	68	68	....	N.		68	68	68	....	S.		64	63	63	....	S.	
22	56	56	56	50	....	S.	69	71	70	....	N W		69	72	70	....	W.		66	66	64	....	W.	
23	48	48	48	48	....	N.	70	71	72	....	S.		71	69	68	....	S.		66	62	61	....	S.	
Mean,	56⅛	56⅛	56	....	....	....	67⅜	68⅛	67⅛	....	....		66⅝	67⅛	66⅝	....	....		65⅞	63⅝	62⅜	....	....	
Highest,	62	62	62	....	....	....	70	71	72	....	....		71	72	70	....	....		66	66	65	....	....	
Lowest,	48	50	48	....	....	....	64	64	63	....	....		62	62	61	....	....		62	62	61	....	....	

OBSERVATIONS—17. Clear. Fresh N. breeze. 18. Few thin clouds. Moderate breeze. 19. Morning few thin clouds. Afternoon cloudy. Moderate breeze. 20. Morning, few thin clouds. Afternoon cloudy. Moderate breeze. 21. Morning few thin clouds. Afternoon thick clouds. Strong N. breeze. 22. Clear. Moderate breeze. Heavy dew. 23. Morning foggy. Clear. Heavy dew. 7 p. m. few clouds. S. breeze.

SEPTEMBER.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a m			12 o'clock m			3 o'clock p m			7 o'clock p m			5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
24	59	59	61	64	61	60	60	62	62	62	62	62	59	59	60	68	63	62	62	62	60	62	62	60
25	57	57	60	60	60	60	60	60	60	56	59	60	57	57	59	60	60	60	60	60	60	56	58	59
26	54	55	57	59	57	58	58	58	58	57	58	58	54	55	57	59	57	58	58	58	58	57	58	58
27	56	56	58	71	63	58	68	63	58	60	63	58	56	56	58	72	63	58	68	63	58	60	63	58
28	60	60	58	77	68	60	77	71	61	64	68	61	69	60	58	80	70	60	80	73	61	64	67	61
29	53	54	58	69	61	60	69	63	61	60	61	61	53	54	58	71	61	59	71	63	61	60	61	61
30	53	54	58	58	58	58	58	58	58	55	56	59	52	53	57	58	58	58	58	58	58	55	56	58
Mean, .	56	56 5/6	58 2/6	65 5/6	61 1/6	59 1/6	64 3/6	62 4/6	59 4/6	59 4/6	61	59 7/6	57 1/6	56 3/6	58 4/6	66 2/6	61 5/6	59 5/6	65 3/6	62 3/6	59 5/6	59 4/6	60 5/6	59 3/6
Highest	60	60	61	77	68	60	77	71	62	64	68	62	69	60	60	80	70	62	71	73	61	64	68	61
Lowest,	53	54	57	58	57	58	58	58	58	55	56	58	52	53	57	58	58	58	58	58	58	55	58	58

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
24	58	58	58	....	....	N.	66	64	63	....	N.	64	62	59	....	N.	62	61	61	62	N.
25	58	58	58	....	58	N.	60	60	60	58	N.	60	60	60	58	N.	60	59	59	56	N.
26	54	54	54	....	54	N.	58	58	58	....	N.	58	58	58	....	N.	56	56	56	....	N.
27	56	56	56	....	....	N.	64	64	64	....	S.	62	62	62	....	S.	60	60	60	60	S.
28	60	60	60	....	....	W.	67	68	67	....	N.W.	69	70	69	....	N.W.	64	64	64	....	N.
29	53	53	53	52	....	N.	62	63	62	....	W.	63	64	63	....	W.	60	59	58	....	W.
30	52	52	52	52	....	S.	56	56	56	56	N.W.	56	56	56	....	N.W.	56	55	54	....	N.
Mean, ..:....	55 1/6	55 2/6	55 2/6	....	....	.....	61 3/4	61 7/6	61 3/6	....	.....	61 5/6	61 1/6	61 3/6	....	.....	59 3/6	59 1/6	58 7/6	....	.....
Highest, ...	60	60	60	....	....	.....	67	68	67	....	.....	69	70	69	....	.....	64	64	64	....	.....
Lowest, ...	52	52	52	....	....	.....	56	56	56	....	.....	56	56	56	....	.....	56	55	54	....	.....

OBSERVATIONS.—24. Morning light dew, hazy clouds. Afternoon cloudy. 5 p. m. commenced raining. Moderate breeze. 25. Cloudy. Showery. Moderate N. breeze. 26. Morning cloudy. Rainy. Rained steady since 5 p. m. of the 24th. Afternoon cloudy. N. breeze. 27. Cloudy. Damp air. Commenced raining 4 p. m. Moderate breeze. 28. Few thin clouds. Moderate breeze. 29. Morning clear. Heavy dew. Foggy. Afternoon few floating clouds. 30. Morning cloudy. Light showers between 11 a. m. and 2 p. m. Moderate breeze.

OCTOBER.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.			5 o'cl'k a. m.			12 o'clock m.			3 o'cl'k p. m.			7 o'cl'k p. m.		
	Surface.	4 inches below the surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
1	50	52	57	59	56	57	57	57	57	54	56	67	50	52	56	59	56	59	57	57	57	54	55	56
2	49	51	57	65	58	57	67	63	58	56	60	68	49	51	56	66	58	57	67	63	58	56	60	58
3	49	53	56	70	64	59	72	67	60	59	63	60	49	52	54	73	64	58	74	67	60	59	62	60
4	50	52	56	76	62	58	78	62	57	54	56	58	50	52	54	78	62	57	78	62	58	54	56	58
5	52	52	55	75	58	57	77	66	60	62	64	60	52	52	54	77	59	56	79	66	60	61	63	60
6	53	53	56	68	60	57	67	61	58	60	61	58	53	53	55	68	60	57	67	60	58	59	60	57
7	53	53	57	69	61	58	63	61	58	60	60	58	53	53	56	70	61	58	63	61	58	59	59	58
Mean,..	50⅞	52⅜	56⅞	68⅞	59⅞	57⅝	68⅝	62⅜	58⅜	57⅞	60	58⅜	50⅞	52⅛	55	70⅛	60	57⅞	69⅛	62⅜	57⅛	57⅞	59⅛	58⅛
Highest	53	53	57	76	64	59	78	67	60	62	64	60	53	53	56	78	64	59	79	67	60	61	63	60
Lowest.	49	51	55	59	56	57	57	57	58	54	56	58	49	51	54	59	56	56	57	57	51	54	55	56

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
1	49	49	49	49	48	....	61	61	61	.06	S.	60	60	60	....	N.	57	56	55	....	N.
2	48	48	48	48	48	....	62	59	59	....	N.	62	62	62	....	N.	59	59	57	....	N.
3	47	47	47	47	47	....	63	63	63	....	N.	65	66	65	....	N.	58	56	56	....	N.
4	50	50	50	50	48	....	63	61	63	....	N.	64	61	64	....	N.	60	60	60	....	N.
5	48	48	48	48	48	....	62	63	62	....	S.	68	67	69	....	S.	62	61	60	....	S.
6	53	53	53	53	52	....	64	64	64	....	S.	64	64	64	....	S.	60	59	58	....	S.
7	53	53	53	53	52	....	64	66	66	....	S.E.	63	63	63	....	E.	61	60	59	....	E.
Mean, ...	49·	49·	49·	49	49	.....	62⁵	62⁷	62⁷	.....	.....	63·	63·	63⁷	.....	.....	61⅜	58	57⅞	.....	.....
Highest, ...	53	53	53	53	52	.....	64	66	66	.....	.....	68	67	69	.....	.....	62	60	60	.....	.....
Lowest.....	47	47	47	47	47	.....	61	59	59	.....	.....	60	60	60	.....	.....	57	56	55	.....	.....

OBSERVATIONS.—1. Light dew. Cloudy. Damp air. Light showers from 11 a. m. to 1 p. m. 2. **Heavy dew. Floating clouds. Moderate N. breeze.** 3. Heavy dew. Few thin clouds. Moderate breeze. 4. **Heavy dew. Clear N. breeze. Leaves begin to fall.** 5. Heavy dew. Clear. Moderate S. breeze. 6. **Heavy dew. Thin clouds. Moderate breeze.** 7. Heavy dew. Morning few thin clouds. Afternoon cloudy. Moderate breeze.

OCTOBER.

DAY OF MONTH.	OBSERVATIONS ON GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clk. a. m.			12 o'clock m.			3 o'clk. p. m.			7 o'clk p. m.			5 o'clk a. m.			12 o'clock m.			3 o'clk p. m			7 o'clk p. m.		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
8	55	55	57	62	59	58	62	61	58	59	58	58	55	55	57	62	59	58	62	61	58	59	58	58
9	53	56	57	62	60	57	55	57	57	53	56	57	53	56	56	62	60	57	55	57	57	52	55	57
10	50	52	56	62	61	58	60	61	58	55	56	58	50	52	55	63	61	58	60	61	58	54	56	58
11	46	48	55	58	57	56	56	57	56	50	53	56	46	48	54	58	57	56	56	56	56	50	52	56
12	42	46	53	50	50	53	50	50	53	50	50	53	42	46	52	50	50	52	50	50	52	50	50	52
13	52	52	53	58	56	55	54	56	55	53	54	55	52	52	53	59	56	55	54	56	55	52	53	55
14	42	45	52	56	56	53	56	56	53	50	52	53	41	44	51	56	56	53	55	56	53	49	51	52
15	40	44	51	50	51	52	50	51	52	55	59	52	39	43	50	50	60	50	49	50	50	44	48	50
Mean,..	47	49	54	57	56	55	55	56	55	51	53	55	47	49	53	51	57	54	55	55	54	51	52	54
Highest	55	55	57	62	61	58	62	61	58	59	58	58	55	56	57	62	61	58	62	61	58	59	58	58
Lowest,	40	44	51	50	51	52	50	50	52	45	49	52	39	43	50	50	56	50	49	50	50	44	48	50

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 oclock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
8	55	55	55	....	....	N.	62	62	62	....	S. E.	60	60	60	....	S.E.	60	60	60	59	S. E.
9	54	54	54	....	....	N.	59	59	59	....	W.	58	58	58	....	N.	56	55	54	....	N.
10	51	51	51	48	....	W.	60	60	60	....	W.	58	58	58	....	W.	53	52	51	....	N.
11	47	47	47	45	....	W.	56	56	56	....	N.W.	56	56	56	....	W.	50	50	50	....	W.
12	47	42	42	38	....	S.	50	50	50	....	S.	51	51	51	....	S.	50	50	50	....	S.
13	52	52	52	....	....	W.	57	57	57	....	W.	54	54	54	....	W.	48	47	47	....	W.
14	42	42	42	32	....	W.	54	54	54	....	W.	53	53	53	....	W.	47	46	46	....	W.
15	36	36	35	32	....	N. E.	48	48	48	....	N.W.	48	48	48	....	N.W.	43	42	42	....	N.W,
Mean,.....	47	48	48	....	....	.....	55	55	55	....	.....	55	55	54	....	.....	50	50	50	....	.....
Highest, ...	55	55	57	....	....	.....	62	62	62	....	.....	60	60	60	....	.....	60	60	60	....	.....
Lowest,....	36	36	35	....	....	.....	48	48	48	....	.....	48	48	48	....	.....	43	42	42	....	.....

OBSERVATIONS.—8. Cloudy. Afternoon slight showers. 9. Few thin clouds. Fresh W. breeze. 10. Few floating clouds. Stiff W. breeze. 7 P. M. clear. Light dew. 11. Heavy dew. Morning clear. Afternoon few clouds. Strong W. breeze. 12. Morning cool. Light dew. Thin clouds. Afternoon cloudy. Strong S. breeze. 13. Few thin clouds. Moderate breeze. Smoky. 14. Morning clear. Light frost. Afternoon few clouds. W. breeze. 15. Few clouds. Heavy frost. Moderate wind.

OCTOBER.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clock a.m			12 o'clock m.			3 o'clock a m			7 o'clock p.m			5 o'clock p m			12 o'clock m.			3 o'clock p.m			7 o'clock p.m		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
16	38	44	50	52	52	51	52	52	51	49	51	51	37	43	48	52	52	50	52	52	50	48	52	50
17	45	46	50	60	52	52	60	55	53	54	53	53	45	45	49	61	52	51	61	55	53	54	54	53
18	47	47	52	....	....	....	64	58	56	59	56	56	46	46	51	....	....	....	64	58	56	57	58	56
19	....	....	....	....	....	....	....	....	....	54	54	54	....	....	....	....	....	....	....	....	....	54	54	54
20	46	47	52	60	57	55	60	47	55	52	55	55	45	46	51	60	57	55	60	57	55	52	53	55
21	41	45	51	....	....	....	57	56	55	54	54	54	40	44	49	....	....	....	57	56	55	54	54	54
22	52	52	54	....	....	....	58	54	54	56	55	54	52	52	53	....	....	....	58	54	53	56	55	53
23	48	50	52	55	53	53	....	....	....	52	53	53	48	50	52	55	53	53	....	....	....	52	53	53
Mean,..	48⅛	47½	50⅛	56⅜	53¼	52⅜	59⅛	53⅜	55	53⅛	54⅛	53⅛	44⅜	46¼	50⅜	57	53	52¼	57⅓	55	54	55⅞	54¼	53¼
Highest	52	52	54	60	57	55	64	58	56	58	58	56	52	52	57	61	57	55	63	58	56	57	58	56
Lowest,	38	44	50	52	52	51	52	54	51	49	52	51	37	43	48	52	52	50	52	52	50	43	52	50

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.					3 o'clock p. m.					7 o'clock p. m.				
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.
16	36	35	35	32	....	S.	54	54	54	....	S.	55	54	54	....	S.	46	46	46	....	S.
17	45	45	45	....	....	S.	60	60	60	....	S.	60	60	60	....	S.	56	56	55	....	S.
18	45	45	45	45	....	S.	....	....	....	....	.....	68	68	68	....	S.	63	63	62	....	S.
19	....	....	....	....	....	.....	....	....	....	....	.....	....	....	....	....	.....	54	54	54	....	W.
20	46	46	46	42	....	N.	60	60	60	....	N.	60	60	60	....	N.	52	52	51	....	N.
21	40	40	40	38	....	W.	....	....	....	....	.....	57	57	57	....	N.	54	53	53	....	N.
22	52	52	52	....	50	S.	....	....	....	....	.....	62	62	62	....	S.	62	62	62	....	S.
23	46	46	46	....	....	W.	52	52	52	....	W.	....	....	....	....	.....	51	51	50	....	W.
Mean,....	44½	44⅛	44⅛	....	....	.....	56½	56½	56½	....	.....	60⅛	60⅛	60⅛	....	.....	54⅔	54⅓	54⅛	....	.....
Highest, .	52	52	52	....	....	.....	60	60	60	....	.....	68	68	68	....	.....	63	63	63	....	.....
Lowest,..	36	35	35	....	....	.....	52	52	52	....	.....	54	54	54	....	.....	46	46	46	....	.....

OBSERVATIONS.—16. Clear. Heavy frost. Ground frozen slightly. Moderate breeze. 17. Morning clear. Light dew. Afternoon few thin clouds. S. breeze. 18. Heavy dew. Very few thin clouds. S. breeze. 19. Cloudy. S. breeze. 20. Heavy dew. Very few thin clouds. N. breeze. 21. Heavy dew. Few clouds. 22. Cloudy. S. breeze. Morning rainy. 23. M

OCTOBER.

DAY OF MONTH.	OBSERVATIONS ON SOIL OF GRASS LAND.												OBSERVATIONS ON NAKED SOIL.											
	5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.			5 o'clk a. m.			12 o'clock m.			3 o'clk p. m.			7 o'clk p. m.		
	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.	Surface.	4 inches below surface.	9 inches below surface.
24	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
25	54	52	52	....	....	....	60	56	54	....	....	....	54	52	52	....	....	....	60	56	54	....	....	....
26	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
27	32	41	46	....	....	....	....	....	....	....	....	....	32	40	45	....	....	....	....	....	....	....	....	....
28	32	40	46	....	....	....	....	....	....	41	44	46	32	39	45	....	....	....	....	....	....	41	44	45
29	32	38	43	....	....	....	54	38	47	....	....	....	32	38	42	....	....	....	54	48	47	....	....	....
30	36	39	43	....	....	....	....	....	....	....	....	....	32	38	42	....	....	....	....	....	....	....	....	....
31	39	40	43	....	....	....	59	54	50	....	....	....	39	40	43	....	....	....	56	54	50	....	....	....
Mean,..	32⅛	35⅝	39	....	....	....	....	....	....	....	....	....	31⅚	35¼	38⅝	....	....	....	....	....	....	....	....	....
Highest	54	52	52	....	....	....	....	....	....	....	....	....	54	52	52	....	....	....	....	....	....	....	....	....
Lowest,	32	38	43	....	....	....	....	....	....	....	....	....	32	38	42	....	....	....	....	....	....	....	....	....

OBSERVATIONS ON ATMOSPHERE, DEW, RAIN, AND WIND.

DAY OF MONTH.	5 o'clock a. m.						12 o'clock m.						3 o'clock p. m.						7 o'clock p. m.					
	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Dew.	Rain.	Wind.	Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.		Air, 4 feet above surface.	Air, 4 inches above surface, naked soil.	Air, 4 inches above surface, grass land.	Rain.	Wind.	
24	....	....	....	....	....	.....	....	....	....	....	.....		....	....	....	....	.....		....	....	....	....	.....	
25	54	44	54	....	54	S. W	....	....	....	....	.....		60	60	60	....	W.		....	....	....	....	.....	
26	....	....	....	....	....	.....	....	....	....	....	.....		....	....	....	....	.....		....	....	....	....	.....	
27	33	33	33	32	....	N.	....	....	....	....	.....		....	....	....	....	.....		....	....	....	....	.....	
28	33	33	33	32	....	N.	....	....	....	....	.....		....	....	....	....	.....		40	38	38	....	N.	
29	32	32	32	32	....	S.	....	....	....	....	.....		53	53	53	....	S.		....	....	....	....	.....	
30	32	32	32	32	....	S.	....	....	....	....	.....		....	....	....	....	.....		....	....	....	....	.....	
31	44	44	44	44	....	S.	....	....	....	....	.....		57	57	57	....	S.		....	....	....	....	.....	
Mean,.....	32¼	32¼	22¼	32¼	....	.....	....	....	....	....	.....		....	....	....	....	.....		....	....	....	....	.....	
Highest, ...	54	54	54	54	....	.....	....	....	....	....	.....		....	....	....	....	.....		....	....	....	....	.....	
Lowest, ...	32	32	33	32	....	.....	....	....	....	....	.....		....	....	....	....	.....		....	....	....	....	.....	

OBSERVATIONS.—25. Cloudy. Morning showery. 27. Heavy frost. Ice froze in vessels exposed ¼ inch thick. 28. Ice froze ¼ inch thick. N. breeze. 29. Heavy frost. Clear S. breeze. 30. Heavy frost. Very few clouds. 31. Heavy dew. Few clouds. S. breeze.

DECEMBER.

DAY OF MONTH.	OBSERVATIONS ON SOIL.										ALBANY BLUE CLAY.				WEATHER.										
	Surface soil.		4 in. bel. surface.		9 in. bel. surface.		2 ft. bel. surface.		4 ft. bel. surface.		2 ft. bel. surface.		4 ft. bel. surface.		Air.				Direction of wind.		Force of wind.		Mean	Degree of cloudiness.		
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 p.m	3 p.m	9 p.m	a.m	p.m	a.m	p.m		a.m	p.m	Mean
1	30	34	33	33	38	38	....	....	....	....	....	....	....	....	....	25	39	....	S	S	....	....		6	6	3
2	38	45	39	39	38	38	....	....	....	....	....	....	....	....	....	51	53	....	S	S	....	....		8	6	7
3	39	37	39	39	38	38	....	....	....	....	....	....	....	....	....	40	36	....	S	N	....	....		8	8	8
4	34	34	37	36	38	37	....	....	....	....	....	....	....	....	....	32	39	....	N	N	....	....		6	3	4½
5	....	35		36		37	....	....	....	....	....	....	....	....	....	....	36	....		S W	....	....			7	....
6	32	34	3	3	37	37	....	....	....	....	....	....	....	....	....	32	36	....	NW	NW	....	....		3	3	3
7	29	32	3	34	36	36	....	....	....	....	....	....	....	....	....	24	36	....	N	S	....	....		0	3	0
8	30	32	3	3	36	36	....	....	....	....	....	....	....	....	....	26	44	....	N	S	....	....		0	3	1½
9	32	46	3	4	36	40	....	....	....	....	....	....	....	....	....	43	53	....	S	S	....	....		7	6	6½
10	52	53	48	50		45	....	....	....	....	....	....	....	....	....	59	60	....	S	S	....	....		6	6	6
11	50	48	50	50		45	....	....	....	....	....	....	....	....	....	50	46	....	W	W	....	....		7	6	6½
12	....	....					....	....	....	....	....	....	....	....	....	....	....	....			....	....				
13	47	53	46		46		....	....	....	....	....	....	....	....	....	52	60	....	S	S	....	....		3	3	3
14	44	46	46	46	46	46	....	....	....	....	....	....	....	....	....	42	44	....	N	N	....	....		6	6	6
15	44	45	45	46		46	....	....	....	....	....	....	....	....	....	42	44	....	N	N	....	....		6	6	6
Semi-monthly mean...	40.04		40.16		40.4																				4.7
16	32	32	30	30	43	42	46	46	51	50½	....	....	....	....	....	24	27	....	N	N		....		6	5	4½
17	33	32	30	32	40	39	47	45	51	50½	....	....	....	....	....	30	32	....	N	N		....		6	6	6
18	32	32	30	30	39	39	45	44	49	50	....	....	....	....	....	28	30	....	N	N		....		6	3	4½
19	32	32	34	35	39	39	43	43	49	49	45	45	49½	48	....	31	33	....	S W	S W		....		2	6	4
20	32	32	36	37	38	38	42	42	50	49	43	45	46½	47	....	27½	31	....	N	N		....		6	6	6
21	30	30	34	3	37	37	42	41½	47	47½	45	44½	48	47	....	14	17	....	NW	N		....		6	3	4½
22	28	28	34	34	38	38	44	41	46	46	42	44	46	46	....	12	18	....	W	N		....		6	6	6
23	28	28	34	34	38	38	41	40½	46½	46½	44	44	46	46	....	21	27½	....	N	S		....		6	6	6½
24	28	28	34	34	38	38	40½	40½	45	45	43	43	45½	46	....	29	32	....	S	S		....		3	3	3
25	28	28	34	34	38	38	40	40½	45	45	43	43	46	46	....	27½	29	....	S W	N		....		3	6	4½
26							39½	39	45	45	43	43	45½	46	....	....	....	....	N			....		3	..	....
27	31		34	34	38	38	39½	39	45	45	47½	42½	45½	45½	....	21	19½	....	N	S	3	3		3	2	2½
28	34	32	34	34	38	38	39	39	44½	44½	42	42	45½	45½	....	25	32	....	S	S	4	3		5	3	4
29	33	33	34	34	38	38	39	39	44	44½	42	42	46	46	....	32	40	....	S	S	2	2		4	4	4
30	34	34	36	36	38	38	39	39	44	44	42	42	46	46	....	35	46	....	S	S	1	2		2	2	2
31	36	38	37	36	38	38	40	40	43	43½	42	42	46	46	....	42	47	....	S	S	1	1		2	3	2½
Semi-monthly mean,..	31.3		34.87		38.47		41.44		46.64		43.11		46.33													4.3
Monthly mean,.....	35.67		37.66		39.44																					4.5

OBSERVATIONS.—2. Light showers. No frost in ground. 3. Rained steady the last 24 hours. Rain changed to snow at 2 p. m. 5. Snow 3 inches deep. 6. A little snow fell between 3 p. m. and night. 7. Soil froze ½ inch deep. 8. Pleasant. 9. Soil froze 2 inches deep. 10. Snow nearly all disappeared. 10. Strong S. breeze. Soil very wet. 11. Heavy rain between 7 and 8 a. m. 13. Rained most of the night. 14. Hazy. 15. Hazy. 27. Snow 6 inches deep. 29. Snow thaws rapidly. 30. Snow nearly all gone. 31. 3 P. M. hazy,

JANUARY, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.				OBSERVATIONS ON TREES.				WEATHER.													
	2 feet below surface.		4 feet below surface.		Black Walnut.		Horse Chestnut.		Air.				Direction of wind.		Force of wind.			Degree of cloudiness.			Inches rain.
	8 a. m	3 p.m	8 a. m	3 p.m	8 a. m	3 p.m	8 a. m	3 p.m	6 a. m	8 a. m	3 p.m	9 p.m	a. m	p.m	a. m	p.m	Mean	a. m	p.m	Mean	
1	40	40	43	43	....	....	....	....	....	48	56	....	S	S	1	3	2	3	3	3	....
2	40	40	43	43	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....
3	40⅛	40	43	43	....	....	....	....	....	32	42	....	N	N	1	1	1	0	0	0	....
4	40	40	43	42⅝	....	....	....	....	....	36	40	....	NW	NW	1	4	2	3	2	1⅛	....
5	39⅝	40	42	42	....	....	....	....	....	24	32	....	N	S	2	7	4	4	5	4⅝	....
6	39	39	42	41⅛	....	....	....	....	....	20	21	....	N	N	5	4	4	1	1	1	....
7	40	39⅛	41	41⅛	....	....	....	....	....	12	22	....	N	N	2	2	2	0	3	1½	....
8	40	40	41⅛	41	....	....	....	....	....	22	25	....	N	N	3	2	2	3	3	3	....
9	39	40	41	42	....	....	....	....	....	....	28	....	N	W	2	6	4	2	2	2	....
10	39	39	41	41	....	....	....	....	....	3	4	....	N	N	1	1	1	0	1	⅛	....
11	39	39	40⅛	40	....	....	....	....	....	11	30	....	N	N	1	1	1	0	0	0	....
12	38	39	40⅛	40	....	....	....	....	....	20	30	....	N	N	1	1	1	2	3	2⅝	....
13	37⅛	38	40	42	....	....	....	....	....	15	32	....	S	S	1	1	1	4	4	4	....
14	37	37	41⅛	42	....	....	....	....	....	34	38	....	S	S	1	1	1	5	4	4½	....
15	37	37	42	42	....	....	....	....	....	40	42	....	S	S	2	3	2	5	6	5½	....
Semi-monthly mean,	39.23		41.72								28						2.18			2.46	
16	35	35	38	39	....	....	....	....	....	36	44	....	NW	N	1	1	1	0	0	0	....
17	35	35⅛	39	39	....	....	....	....	....	33	38	....	S	W	1	2	1½	2	1	1½	....
18	35	35	38⅛	38	....	....	....	....	....	29	29	....	S	N	3	7	5	3	3	3	....
19	35	35	38	38	26	25	26	25	....	9	19	....	N	N	2	2	2	0	0	0	....
20	34⅛	34⅛	37⅛	37⅛	26	32	21	25	....	21	36	....	S	S	4	2	3	3	1	2	....
21	34⅛	35	37⅛	38	32	32	27	29	....	33	42	....	S	S	4	2	3	4	2	3	....
22	35	35	38	38	31	31	30	29	....	25	42	....	N	N	1	2	1½	1	3	2	....
23	35	35	38	38	30	31	27	27	....	21	28	....	N	N	2	2	2	3	1	2	....
24	35	34⅛	38	37⅛	30	29	28	24	....	....	30	....	N	S	2	2	2	0	0	0	....
25	34⅛	34⅛	37⅛	37⅛	30	32	26	29	....	32	40	....	S	S	3	2	2½	2	3	2½	....
26	34⅛	34⅛	37⅛	38	32	33	29⅛	30	....	33	36	....	N	N	1	2	1½	3	5	4	....
27	34⅛	34	37⅛	38	34	34⅛	30	31	....	37⅛	38	....	N	N	2	2	2	4	6	5	....
28	34⅛	34⅛	37⅛	37	35⅛	38	31	31	....	39	40	....	N	W	1	1	1	0	1	⅛	....
29	34⅛	34⅛	36⅛	37	32	35	30	30⅛	....	31	35	....	NW	W	3	3	3	4	4	4	....
30	34⅛	34⅛	37⅛	37	32	35	31	30	....	32	32	....	W	W	1	3	2	1	2	1	....
31	34⅛	34⅛	37⅛	37	32	35	31	32	....	31	41	....	N	S	1	3	2	1	2	1½	....
Semi-monthly mean,	34.7		37¾		37						32¼										
Monthly mean,																					

OBSERVATIONS.—1. Hazy. Warm S. breeze. 3. Heavy frost in morning. Warm day. 5. Snow ¼ inch deep. High wind. 6. Cold N. Wind. 8. Light fall of snow. 9. Snow fell last night 8 inches deep. Strong W. breeze. 10. Very cold. 11. Very cold. 14. Light showers of rain. 15. Light showers occasionally. 16. Snow has nearly disappeared. Soil froze 6 inches deep. 17. Light frost during night. 20. Cold S. wind. 26. Smoky. Light showers during the afternoon. 27. Morning foggy. Smoky. Rain from 10 a. m. to 4 p. m. 28. Morning foggy and smoky. 30. Light fall of snow. White frost during the night. 31. Soil froze ¼ inch deep during night.

FEBRUARY, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.				OBSERVATIONS ON TREES.				WEATHER.												
	2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air				Direction of Wind.		Force of Wind.			Degree of Cloudiness.			Inches of Rain.
	8 a. m	3 p.m	8 a. m	3 p.m	8 a. m	3 p.m	8 a. m	3 p.m	6 a. m	8 a. m	3 p.m	9 p.m	a. m	p.m	a. m	p.m	Mean.	a. m	p.m	Mean.	
1	34	34	36½	36½	30	30½	32	33	25	28	33	36	N	W	1	2	2	1	1	1	0.52
2	34	34½	36½	36½	31	31	31	32	22	24	37	30	N	N	1	1	1	1	1	1	....
3	34	34	37	36½	30	30	31	31	13	14	31	30	N	S	1	1	1	1	2	1½	....
4	34	34	37	36	30	30	31	31½	28	31	38	35	N	SE	1	1	1	5	3	4	1.15
5	34	34	36½	36½	30	30	32	32½	33	33½	33	29	N	N	1	1	1	5	5	5	
6	34	....	36½	....	30	....	31	....	27	29	....	26	N	....	4	....	2	5	....	2½	0.10
7	34	34½	36½	36½	30	30	30	30	26	24	28	22	N	N	4	4	4	2	2	2	....
8	34	34½	37	36½	27	28	27	28	12	14	28	10	N	N	1	1	1	0	0	0	....
9	34	34	36½	37	18	23½	22	28	1	7	33	23	N	N	1	1	1	0	0	0	....
10	34	34	36½	36½	23½	26	28½	30	26	24½	26	14	N	N	1	5	3	2	1	1½	....
11	33½	33½	36	36½	11	16	20	25	-1	1	18	4	N	NW	2	2	2	0	0	0	....
12	33	33	36	36	7	10	16	21	-3	1	19	12	N	N	1	1	1	0	1	1	....
13	33½	33½	36	36	9	....	17	....	0	2	20	16	N	N	1	1	1	0	1	½	....
14	33½	33½	36	36	9	15	16	19	4	4	25	17	N	N	1	1	1	3	2	2½	....
15	33½	33½	36	36	14	23	18	17	14	25	32	26	N	N	1	3	2	0	0	0	....
Semi-monthly mean,	34		36½						31												
16	33½	33½	36	36	25	27	25	29	24	26	40	26	N	N	1	1	1	0	0	0	....
17	33½	33½	36	36	23	26	17	28	10	12	32	23	N	N	1	1	1	0	0	0	....
18	33½	33½	36	36	23	25	23	27	8	13	38	25	N	N	1	1	1	0	0	0	....
19	33	33½	36	36	20	26	22	29	12	10	36	36	N	N	1	1	1	0	1	½	....
20	33	....	36	....	....	....	....	....	36	36	....	38	S	....	1	....	½	4	....	2	0.29
21	33	33	36	36	30	30	33	33	43	42	46	40	SW	W	3	4	3½	2	1	1½	....
22	33½	33½	36	36	30	31	33	34	36	34	36	38	S	S	1	1	1	3	3	3	0.18
23	33½	33½	36	36	30½	31	33½	38	37	36	47	39	S	S	1	1	1	3	2½	2½	....
24	33	33	36	36	30	30	32	32	29	30	30	27	W	W	2½	2	2½	4	4	4	....
25	33	33	35½	35½	30½	30	28	31	12	14	24	17	NE	NE	2	2	2	0	9	0	....
26	33	33	35½	35½	29	30	26	31	9	15	31	27	N	S	1	2	1½	0	0	0	....
27	33	33	35½	35½	28	30	30	32	22	28	35	22	S	S	2	2	2	1½	2	2	0.10
28	32½	32½	35	35½	26	25½	28	28	10	11	29	31	S	S	2	3	2½	1	4	2½	0.03
29	32	33	35	36	27	28	30	30	31	31	32	23	W	SW	3	4	3½	2	3	3	....
Semi-monthly mean,	33		36						29												
Monthly mean.																					

OBSERVATIONS.—1. Snow fell 6 inches deep last night. Thaws slowly in sun. 2. Hard frost last night. Thaws slowly in sun. 3. Thaws slightly in sun. Freezes in shade. 4. Light snow storm in morning. P. m. warm, thaws fast. 5. About 4 inches of snow fell last night. Commenced snowing again at 12 m. 6. Snow 10 inches deep. Snow has been falling almost continually since 12 m. yesterday. Snow damp. 7. Snow 12 inches deep. Drifts some. 8. Thaws slightly in sun. Good sleighing. 9. Clear. Smoky. Thaws slightly in sun. 10. Smoky. Pleasant. 11. Clear and cold. 12. Cold, very. 11. Snow 10 inches deep. 15. Smoky. 16. Smoky. P. m. warm 17. Smoky. Cold morning. 18. Smoky. Thaws fast in sun. 19. Smoky. Snow is disappearing rapidly. 20. Rain and hail early a. m. to 2 p. m. Temperature 36°. 21. Snow nearly gone. 22. Rain and snow 12 m. afternoon and evening. 25. Snow disappearing rapidly. 27. Smoky. 28. Snow p. m. 29. Snow a. m. Snow 1 inch deep.

MARCH, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.				OBSERVATIONS ON TREES.				WEATHER.													
	2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of wind.		Force of wind.			Degree of cloudiness.			Rain inches.
	8 a. m	3 p.m	8 a. m	3 p.m	8 a. m	3 p.m	8 a. m	3 p.m	6 a. m	8 a. m	3 p.m	9 p.m	a. m	p. m	a. m	p.m	Mean.	a. m	p.m	Mean.	
1	33	33	36	36	23	24	27	28	16	18	25	19	N	N	1	5½	3½	1	1	1	....
2	33	33⅓	36	35	18	23	23	26	11	16	27	24	W	N	1	2⅓	1⅔	1	2	1½	0.41
3	32⅔	33	35½	35	21	23	24½	26	29	20	27	27	N	S	4	2	3	4	4	4	....
4	33	33	36	36	20	26	25	28	20	21	32	30	N	W	0	1	½	0	3½	2½	0.04
5	....	33	....	36	....	....	....	....	23	23	22	18	....	NW	....	6	3	....	4	2	0.02
6	33	33	36	35⅔	19	24	23⅔	27	14	20	31	33	S	S W	3	2	2½	3	4	3	....
7	33	33	36	35	26	29	28	29	26	28½	44	42	S	S	2	1	1½	2	1	1½	....
8	33	33	35	35	30	31	32	36	36	32	52	50	S	S	0	3	1½	0	2	1½	....
9	33	33	35	35	31	32	35	36	37	36	44	29	S W	S	4	2	3	4	4	1	0.18
10	33	33	36	35	30	30	30	31	21	24	30	23	NW	NW	4½	4	4	4½	4	4	1.08
11	33	33	35	35	30	30	29	32	14	24	32	24	N	N	1	2	1½	1	1	1¼	....
12	....	33	....	35	....	....	....	....	9	16	38	40	....	S	....	3	1½	....	4	2	....
13	33	33	35	35	30	30	32	33½	36	32	34	25	SW	W	0	2	1	0	4	2	....
14	33	33	35	35	30	30½	30	30½	12	16	26	11	W	W	1	3	1½	1	2	1	....
15	33	33	35	35	20	23	23	26	1	6	12	9	W	W	0	2	1	0	1	½	....
Semi-monthly mean,	33		35⅔						25¼												
16	33	33	35	35	10	19	18	25	1	6	23	10	N	N	0	1	⅓	0	0	0	....
17	32¼	32½	35	34⅓	10	21	18	25	1	10	32	22	N	N	0	1	⅓	0	0	0	....
18	32¼	32½	34½	34½	21	23	25	25	22	25	37	27	S	S	1⅓	1	1½	3½	3	3½	....
19	32¼	32½	34½	34½	23	....	27	....	18	28	42	38	S	S	1	1	1	0	3	1½	0.15
20	32½	32¼	34¼	34⅓	29	29	32	33	35	37	43	44	W	S	1	2	1½	0	3	1½	0.12
21	32½	32½	34½	34¼	31	33	35	38	39	42	49	44	S W	W	2	3	2⅓	3	4	3⅓	....
22	32¼	32¼	34¼	34¼	31	34	35	38	34	37	48	39	W	W	1	2	1½	1	3	2	....
23	32½	32¼	34½	34½	32	34	34	38	35	36	48	38	N	S	1	1	1	4	3	3½	0.17
24	32¼	32½	44¼	34⅓	31	34	33	36	34	32	48	35	S	S	2	2	2	4	2	3	....
25	32½	32½	34½	35	31	36	32	35	28	32	53	46	S	S	1	1	1	0	1	½	....
26	32½	32½	34¼	34¼	36	38	32	41	43	44	46	46	S	S	2	2	2	4	5	4½	....
27	32¼	32⅔	34½	34¼	37	38	40	40	41	41	42	43	S	NW	1	1	1	4	4	4	0.61
28	32¼	32⅔	34	34¼	37	38	40	41	40	42	44	44	N	N	1	1	1	5	6	5½	....
29	32¼	32½	34½	34½	38	42	40	44	41	42	53	45	NW	W	2	3	2½	4	1	2⅔	....
30	32⅓	32⅔	34½	34½	37	47	40	48	35	39	66	50	W	S	1	1	1	0	1	½	....
31	32½	32½	34½	34¼	48	57	49	61	50	50	66	62	S	S	2	4	3	2	3	2⅔	....
Semi-monthly mean,..	32½		34¼						37¼												
Monthly mean,.....																					

Observations.—1. Cold wind. 2. Snow 9 a. m. to noon of 3d. 3. Snow 8 inches deep. 4. Snow early a. m. 5. Snow early a. m. 6. Wind shifted at about 12 m. at night. 7. Thaws fast. 8. Froze slightly during night. 9. Rain during night and early a. m. Snow, rain and hail 4¼ p. m., till 2 p. m. of the 10th. 11. Thaws fast in sun. 12. Smoky. 13. Smoky. 14. Smoky. 19. Rain and snow 6 p. m. 20. Rain 5 p. m. 21. Strong wind during night. 23. Snow and rain early a. m., occasional showers during the day and night. 26. Rain 2 p. m. to 12 m. at night. 27. Hazy, slight showers. 28. Rain early a. m. till 12 m. at night. 29. Smoky 30. Smoky.

APRIL, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.				OBSERVATIONS ON TREES.				WEATHER.													
	2 feet below Surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of Wind.		Force of Wind.			Degree of cloudiness.			Inches of Rain.	
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a.m	3 p.m	9 p.m	a.m	p.m	a.m	p.m	Mean	a.m	p.m	Mean		
1	33	33	34½	35	48	49	49	50	49	50	50	37	W	W	4	4	4	3	2	2	0.22	
2	33	33	34½	35	.....	.....	.....	.....	31	50	47	38	SW	W	4	4	4	2	1	1½	....	
3	34	34	36	36	37	44	38	46	30	34	54	44	S	S	1	3	2	1	2	1½	....	
4	33	33	36	36	39	43	41	44	39	39	44	48	S	S	5	4	4½	4	6	5	0.43	
5	33	33½	36½	37	45	47	45	49	48	47	54	41	W	W	2	2	2	2	1	1½	....	
6	39	39	38	38	42	48	41	50	32	40	56	44	W	W	1	2	1½	0	1	½	....	
7	40	40	39	38	42½	49	43	49	33	42	60	42	W	W	2	3	2½	0	0	0	....	
8	41	41	40	39	43	51	43	53	32	42	64	51	W	W	1	1	1	0	0	0	....	
9	42	42	40	40	48	52	47	53	38	38	75	51	W	W	1	1	1	0	0	0	....	
10	44	44	41	40½	51	51	50	52	39	44	74	63	W	W	1	3	2	0	1	½	....	
11	45	45	42	41	53	51	52	52	43	50	71	55	W	N	1	2	1½	0	0	0	....	
12	46	46	44½	42	53	57	52	55	47	44	59	52	S	S	1	2	1½	4	4	4	0.07	
13	46	45½	43	42½	52	51	50	50	42	43	41	39	S	W	1	2	1½	4	5	4	0.19	
14	45	44	43	43	43	46	44	44	36	44	51	44	S'	S	1	1	1	2	3	2½	0.04	
15	41	43½	42	42½	41	51	41	53	34	43	65	54	N	NW	1	1	1	1	1	1	....	
Semi-monthly mean,	39¾		39½						46½													
16	44½	45	43	42½	48	55	48	57	41	48	66	55	W	W	1	2	1½	0	0	0	....	
17	46	46	44	43	51	57	51	56	43	47	39	44	N	W	1	2	1½	1	0	½	....	
18	46½	46	43	44	45	48	45	48	34	38	51	35	N	N	1	2	1½	4	3	3½	0.03	
19	45	11	43	44	40	44	37	43	30	31	48	35	N	N	3	3	3	4	2	3	....	
20	44	43½	44	44	35	46	36	48	27	35	60	45	N	W	1	2	1½	0	1	½	....	
21	44	44	44	44	43	55	44	56	37	44	70	58	S	W	1	2	1½	0	1	½	....	
22	46	46	44	44	53	62½	52	62	50	51	74	52	S	N	1	1	1	2	3	2½	0.02	
23	47	....	45	....	52	....	52	....	50	41	....	40	N	....	1	....	....	1	....	....	....	
24	48	48	45	45	....	55	....	54	40	....	52	42	W	W	4	5	4½	2	2	2	0.08	
25	47	47	45	45	46	51	46	52	36	45	62	57	W	W	1	2	1½	1	1	1	....	
26	47	47	45	45	52	54	50	54	47	46	59	49	W	N	2	1	1½	5	3	4	....	
27	47	47	45½	45	48	53	47	54	36	45	65	49	N	N	1	1	1	0	1	½	....	
28	48	47½	46	45	50	56	48	57	37	43	69	56	S	S	1	3	2	0	2	1	0.08	
29	48	48	46	46	54	54	53	53	53	51	50	45	S	W	5	2	3½	5	5	5	....	
30	47	47	46	46	55	54	57	53	38	37	65	52	W	N	2	2	2	1	0	½	....	
Semi-monthly mean,	44½		44½						48													

OBSERVATIONS.—1. Rain. 3. Smoky. 4. Rain. Thermometer 48°. 5. Smoky. 6. Smoky. 7. Smoky. 8. Smoky. 9. Smoky. 10. Smoky. 11. Smoky. 12. Rain early. 13. Rain from 11 a. m. to 6 p. m. 14. Rain and hail p. m. 15. Buds of the Horse Chestnut begin to swell. 16. Morning foggy. Smoky. 17. Smoky. 18. Snow p. m. 20. Light dew. Smoky. 22. Rain p. m. 24. Rain early a. m. 25. Smoky. Leaves begin to show themselves on the Horse Chestnut. 26. Smoky. Lilac leaves ¾ inch long. 29. Rain a. m. Ostrya virginica in flower. 30 Light dew. Currant and Gooseberry in flower.

MAY, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of wind.		Force of Wind.			Degree of cloudiness.			Inches rain.
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a.m	3 p.m	9 p.m	a. m	p.m	a. m	p.m	Mean	a. m	p.m	Mean	
1	50	54	51	51	47⅔	47⅔	46	46	52	57	50	56¼	39	51	62	53	N	S	1	4	2½	1	5	3	0.10
2	51	55	51	51	48	48	46	46	54	57	53	56	51	52	64	54	S	SW	1	1	1	4	5	4½	1.34
3	53	54	52	53	48	48	46	46	54	55	53	54	51	53	61	53	N	N	1	2	1½	6	3	4	....
4	50	58	51	53	48⅓	48½	46	46	52	59	50	61	45	51	78	67	E	NE	1	1	1	0	1		....
5	56	60	54½	55	50	50½	46½	46½	59	62⅔	58	62	57	57	72	65	S	S	3	3	3	3	2	2	0.37
6	58	60	56	60	51⅓	52	47	47	63	67	62½	69	62	64½	83	75	S	S	1	1	1	2	1	1	0.31
7	60	67	59	61	53⅓	54	47½	48	68	68	67	72	65	63	84	65	N	S	1	2	1½	0	0	0	0.05
8	58	64	58	61	55	54½	48⅔	49	60	61	62	67	53	58	72	66	W	W	1	2	1⅔	1	2	1	....
9	57	58	58	57	55	54⅓	49⅓	49⅓	58	57	61	60	53	53	62	54	NW	N	1	1	1	5	3	4	0.29
10	56	59	57	56	54	53	50	50	54	58	56	60	54	53	67	55	S	S	2	4	3	4	5	4½	2.32
11	56	54	56	54	53	53	50	50	54	52	55	52	50	47⅓	50	49	S	N	2	2	2	6	6	6	
12	53	56	54	55	52	52	50⅓	50	50	52	49	51⅓	49	52	60	57	NW	W	3	2	2½	3	4	3½	....
13	53	58½	54½	55½	52	52	50	50	51	53	49	55	46	52	65	55	N	S	1	3	2	2	3	2½	....
14	53	54	55	55	52	52	50	50	52	51	50	51	45	45	55	53	W	W	3	4	3½	5	5	5	0.03
15	53	57	54	55	59	51	50	50	50½	54	50	57	47	52	69	61	W	W	2	3	2½	0	1	½	....
S. m. me.,	36.18		54.78		51.4		48.28								57⅔										
16	55	59	55	56	52	52	50	50	56	57	57	59	57	56	69	60	S	W	2	1	1½	5	3	4	0.10
17	55	60	56	57	52	52	50	50	56	57	56	54	53	56	70	66	S	W	1	3	2	1	1	1	....
18	55	62	55	58	53	53	50	50	56	60	59	67	53	56	84	70	SW	SW	1	3	2	0	0	0	....
19	57	64	58	58	53	53	50	50	60	61	65	72	60	65	90	77	S	S	1	1	1	0	1	½	0.41
20	61	65	59	61	54½	55	50½	50½	63	62½	71	73	65	67	72	71	S	E	2	1	1½	3	5	4	0.41
21	62	65	62	62	56	56	51	51	64	65	71	73	66	67	82	66	N	S	1	1	1	3	2	2½	1.41
22	62	64	61	61	57⅓	57	52	52	64	63	68	67	66	65	72	63	E	N	1	2	1½	6	3	4½	0.03
23	62	64	62	61	58	57	52½	52¼	62	62	64	65	62	62	75	69	W	W	1	1	1	5	3	4	....
24	62	62	62	61	58	57	53	53	62	62	64	65	63	63	64	64	S	S	3	3	3	4	5	4½	....
25	61	64	61	61	57⅓	57	53½	53¼	61¼	63	63	66	62	60	79	71	S	S	2	3	2½	5	1	3	....
26	63	65	62	63	57⅔	58	53½	53½	65	64	68	70	67	67	81	68	E	E	1	2	1½	1	3	2	....
27	60	65	61	61	58	58	54	53½	62	62	65	70	57	63	80	68	N	W	1	1	1	0	1	½	....
28	60	65	60½	61	58	58	55	55	62	62	65	70	62	59	80	70	S	E	1	1	1	2	1	1½	....
29	62	65	61	62	58	58	54	54	63	64	68	71	65	65	78	70	S	S	2	7	4½	2	1	1½	....
30	64	64	62	62	58	58	54	54	66	67	60	70	69	67	70	65	S	S	2	2	2	5	6	5½	0.89
31	60	62	60½	60½	58½	58	54½	54½	59	59	60	61	54	56	59	51	W	W	4	4	4	4	3	3½	....
S.m. me.,	61½		60		56½		52½								66¼										
Mo. mean,																									

Observations.—1. Rain 6 to 8 p. m. Heavy dew in morning. 2. Rain 5 p. m. to 10 a. m. of the 3d. Tem. 53°. 3. Horse Chestnut buds at 8 a. m. Tem. 54°. 4. Heavy dew. 5. Rain early a. m. 6. Flower panicles of the Horse Chestnut begin to appear. Rain from 2 to 4 p. m. thunder shower. 7. Rain early a. m. Thunder shower. 8. Buds of the Black Walnut begin to swell. 9.Rain a. m. Tem. of rain 56°. Young twigs of Horse Chestnut from 9 to 11 inches long, those of the lilac from 10 to 14 inches long. 10. Rain a. m. 0.02. Rain 3 p. m. 11. Rain till late in the evening. Tem. 48°. 12. Lilac in flower. Horse Chestnut begins to flower. 14. Rain early a. m. and p. m. 16. Rain early a. m. Tem. 55°. 17. Heavy dew. 18. Heavy dew. 19. Rain from 9 to 11 p. m. Thunder shower. 20. Rain 12 m. to 3 p. m. Tem. 71°. Thunder. 21. Rain 2 p. m. to 11 a. m. of 22d. Tem. 65°. Pinguicula vulgaris, Polygala paucifolia, Uvularia sessilifolia and Convalaria bifolia in flower. 22. Rain p. m. 23. About ¾ of the top of the Black Walnut is dead. Horse Chestnut shedding its petals. 24. Erythronium albidum and americanum in flower. 25. Slight shower. Viburnum roseum in flower. 26. Heavy dew. Tem. 66°. 27. Heavy dew. Tem. 58°. 28, Poa pratensis and Triticum repens begin to head. 30. Rain early a. m. to 4 p. m. and from 6 to 7 p. m Tem. of rain p. m. 68°.

JUNE, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOILS.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of Wind.		Force of Wind.			Degree of Cloudiness.			Inches rain.
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a.m	3 p.m	9 p.m	a.m	p.m	a.m	p.m	Mean	a.m	p.m	Mean	
1	56	60	59½	60	57½	57	55½	55½	53½	55	53	57	42	48	62	56	W	W	3	5	4	1	1	1	....
2	55	60	58	60	56	56	54½	54½	54	58	54	62	51	58	78	70	S	S	2	3	2½	1	1	1	....
3	58	63	59	62	56	56	54	54	60	62	62	66	62	64	77	71	S	S	2	1	1½	4	3	3½	....
4	63	65	62	63	56½	56½	54	54	63	63	66	72	63	70	86	75	N	S	1	1	1	1	1	1	....
5	65	71	63½	65	59	59	54	54½	65	64	70	73	70	70	80	65	S	S	2	2	2	2	2	2	0.53
6	64	67	64	66	60	60	55	56	63	62	66	76	62	60	69	56	N	W	2	4	3	2	2	2	0.04
7	60	61	63	62	59½	59½	56	56	56	58	60	59	51	53	56	54	W	NW	2	3	2½	4	4	4	0.06
8	59	63	61	62	58½	58	56½	56	57	59	57	60	54	57	70	63	N	N	2	2	2	4	3	3½	0.05
9	60	68	61	64	58	58	56	56	60	62	60	68	57	63	86	70	N	N	2	2	2	2	1	1½	....
10	62	69	63	64	59	59	56	56	62	62	64	67	64	63	74	66	S	SW	2	3	2½	3	4	3½	0.28
11	64	72	64	66	59	59½	56	56	63	63	65	69	64	68	72	65	W	W	1	3	2	0	1	½	....
12	62	68	63½	64	60	60	56½	56	58	59	60	61	49	54	62	52	W	W	2	5	3½	1	1	1	....
13	59	68	63	63	59½	59	56	57	54½	58	55	59	46	50	66	59	W	W	4	5	4½	2	1	1½	....
14	61	65	63	62	58½	59	57	57	57½	60	57	61½	53	58	72	62	NW	W	2	3	2½	1	1	1	....
15	64	68	63	64	59	59	57	57	61	62	63	68	62	66	82	69	S	S	1	2	1½	1	1	1	....
S.M.me.,	63½		62½		58½	55	59⅞		63				63½								2½			1.8	0.97
16	67	76	65	68	60½	61	56	56½	66	67	70	75	70	79	94	85	NW	NW	1	1	1	0	0	0	....
17	70	77	68	71	62½	63	57	57	69	68	74	77	72	78	90	82	W	S	1	2	1½	0	1	½	....
18	72	77	70	71	64½	63	58	58	71	71	76	78	75	74	87	79	S	S	1	2	1½	1	6	3½	0.26
19	71	78	70	70	65½	65½	58	59	72½	71	76	78	77	74	84	79	S	S	1	3	2	3	5	4	0.02
20	71	77	70	72	66	66	60	60	72	71	75	75	75	70	82	69	S	S	1	1	1	6	1	3½	0.23
21	69	72	69	72	66	66	60	60	68	68	71	73	67	70	84	69	S	W	1	3	2	1	2	1½	0.92
22	68	....	68	....	66	....	60	60	67	....	68	....	64	70	....	70	W	S	2	2	2	1	....	1	....
23	68	73	68	71	66	66	60	60½	68	70	69	73	69	71	80	73	S	S	1	5	3	3	6	4	0.34
24	67	72	68	68	66	66	61	61	67	67	68	69	65	64	76	65	W	W	2	5	3½	4	1	2½	....
25	65	72	66	68	65	64½	61	61	64	66	64	67	60	66	80	70	W	W	2	3	2½	1	1	1	....
26	66	74	67	68	64½	64½	61	61	67	67	68	69	63	66	83	76	NE	NE	1	1	1	1	3	2	....
27	69	74	69	69	65	63½	61	61	69	70	70	72	68	70	86	78	S	S	3	3	3	3	2	2½	....
28	70	78	70	72	66	66	61	61	72	72	72	73	74	75	88	71	S	S	2	2	2	4	6	5	1.74
29	70	70	70	70	67	67	62	62	70	71	70	70	69	72	82	76	N	W	1	2	1½	6	1	3½	....
30	71	74	70	70½	67½	67½	62	62½	71½	72	71	72	73	74	81	73	S	E	1	1	1	4	4	4	0.24
S.M.me.,	71.79		69.3		72.2		59.94		69.23		71.96				74.57						1.9			2.6	3.75
Mo.mean	67.56		65.95		65.30		57.47		64.52		67.48				68.95						2.28			2.2	4.72

OBSERVATIONS.—1. Cypripidium acaule in flower. 3. Slight sprinkle in the morning. 4. Poa pratensis in flower 5. Rain early a. m. and 4 to 7 p. m. 6. Rain 6 to 7 a. m. 7. Rain 6 to 8 p. m. and 12 m. at night. 8. Rain 9 to 10 a. m., and 9 to 10 p. m. 10. Rain 4 to 5 p. m. and light showers from 7 to 11 p. m. 11. About ⅛ of the top of the Black Walnut tree is covered with leaves, the rest was killed by fire last September. 18. Rain 2 to 4 p. m. with thunder, and from 9 to 12 p. m. occasional showers. Very warm. 19. Slight showers occasionally from 10 a m to 3 p. m. 20. Rain from 10 p. m. to 21st 12 m. 21. Rain 7 p. m. to 5 a. m. of the 22d. Thunder. The Black Walnut begins to send out new shoots. Triticum in flower. 22. Scirpus tenuis in flower. 23. Heavy shower 3 to 5 p. m. and 9 to 10 p. m. 24. Conium maculatum, Verbascum blattaria, Lilium philadelphicum and Glyceria fluitans in flower just S. of Albany. The Phleum pratense begins to flower. 28. Heavy rain 3 p. m. to 9 p. m. of the 29th. Thunder. The new shoots of the Black Walnut increase rapidly in size and number. 30. Rain 5 to 7 a. m. and 4 to 6 p. m. Heavy thunder storm.

Winds.—North 3½, South 13, East ½, West 9½, Northwest 2, Northeast 1, Southwest ½, Southeast 0.

Weather.—Rain on 12 days. Warmest day 16th. Coldest day 1st. Highest temperature 94 degrees. Lowest temperature 42 degrees.

JULY, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOILS.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of Wind.		Force of Wind.			Degree of cloudiness.			Inches rain.
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a.m	3 p.m	9 p.m	8 a.m	3 p.m	a.m	p.m	Mean	a.m	p.m	Mean	
1	70	74	70	71	67⅜	67⅜	62⅜	62⅜	71	71	70	71	71	76	78	68	S	N	2	2	2	2	3	2½	0.38
2	68	73	69	70	67⅜	67⅛	62⅛	62⅛	66	67	65	67	60	76	80	72	S	S	1	3	2	1	2	1½	....
3	69	68	69	69	67	67⅛	63	62⅜	69	69	70	69	60	69	65	65	S	S	2	2	2	6	7	6½	0.72
4	66	70	67	68	67	66	62⅜	63	64	66	63	65	62	65	72	64	W	W	2	2	2	2	2	2	....
5	66	72	67	69	65	65	63	63	64	67	62½	67	60	66	78	66	W	W	1	2	1½	0	1	1½	....
6	66	70	67	67	65	65⅜	62⅛	62⅛	65	65	63	65	58	60	74	65	NW	N	1	1	1	1	2	1½	....
7	66	67	68	66⅛	65	64⅜	62⅛	62⅛	65	65	63	65	60	62	71	63	N	NE	1	2	1½	2	4	3	....
8	64	70	65	68	64	64	62	62	63	65	63	65	58	63	75	67	SE	E	2	2	2	2	2	2	....
9	65	66	66⅛	66	64	64	62	62	64½	65	63	65	62	61	75	67	E	S	2	2	2	6	4	5	0.27
10	66	70	66½	67	64	64	62	62	65	66½	65	67	64	65	81	72	N	NE	1	2	1½	5	3	4	....
11	68	74	68	71	64⅛	64⅛	62⅛	63	69	70	69	71	70	70	89	77	S	S	1	3	2	4	1	2½	....
12	70	75	69	71	66	66	62	62⅛	71	71	71	71	73	74	86	78	E	S	1	2	1½	4	1	2½	....
13	72	71	71	72	66⅛	67	62	62⅛	73	71	72	71	75	76	75	68	S	S	2	1	1½	4	6	5	1.82
14	70	74	70	70	67	67	63	63	69	70	69	69¾	65	71	84	77	N	W	1	2	1½	1	1	1	....
15	70	73	69	70½	67	67	63	63	69	69	68	68	66	72	78	69	W	W	2	3	2½	1	1	1	....
8m m.	69.43		68.9		65.8		62.52		67.5		67.11			69.82							1.77			2.7	3.19
16	67	68	68	68	67	67	63½	63½	65½	66½	65	65	63	65	71	61	N	W	3	3	3	2	4	3	....
17	..	..	..	..	..	..	..	..	..	..	..	..	58	..	..	68	....	....	..	..	..	..	..	..	....
18	..	..	..	..	..	65	..	63	..	68	..	69	62	..	85	73	S	S	..	2	..	..	1	..	....
19	..	72	..	69	65	65½	62½	63	68	71	67	71	65	73	84	77	S	S	2	1	1½	1	1	1	....
20	67	74	67	69	66	66	63	63	71	72	70	71	70	76	88	78	W	S	1	2	1½	1	1	1	0.13
21	69	73	70	70	67	67	63	63	71	71	70½	71	72	77	88	80	S	S	1	2	1½	1	1	1	....
22	71	74	71	71	67½	67	63	63	73½	73	73	73	73	81	86	73	S	S	3	4	3½	2	3	2½	1.35
23	68½	71	68½	68	67½	67½	64	64	71	71	71	70	68	70	80	72	N	N	1	1	1	5	2	3½	
24	68	72	68	68	67½	67½	64	64	70	69½	70½	69	68	72	82	73	W	N	2	2	2	4	3	3½	....
25	67½	70	68	68	67½	67½	64	64	70	70	69	69	69	70	79	75	S	W	2	1	1½	4	5	4½	....
26	68	72	68	68	67½	67½	64	64	71½	72	70	70	70	74	86	76	W	NE	1	1	1	1	2	1½	....
27	71	73	69	70	68	68	64	64	74	74	73	73	76	79	87	73	S	S	4	5	4½	2	2	2	0.67
28	67	69	68	68½	68½	68½	64	64	71	71	69	69	67	69	83	70	W	W	1	2	1½	2	2	2	....
29	65	69	66	68	68	68	64	64½	69	70½	67	68	65	69	80	71	N	S	1	1	1	3	3	3	....
30	66	69	66½	68	68	67½	64	64	69	71	66	69	63	72	82	73	NE	SE	1	2	1½	1	1	1	....
31	65	67	66	66	67½	67½	64	64	69½	70	69½	70	66	66	74	67	S	S	2	5	3½	5	2	3½	2.58
S.m.m	69.23		68.25		67.3		63.18		70·59		69.52			73.85							2.04			2.36	4.73
M.me.	69.33		68.57		66.55		63.1		69.04		68.31			71.83							1.91			2.53	

Observations—1. Thunder shower 12 to 2 p. m. 3. Rain 7 a. m. to 3 p. m. 6. Chimaphila unbellata and Pyrola secunda in flower. 8. Grasshoppers increase rapidly. Slight shower 6 to 9 a. m. Rain 3 p. m. and during night. 10. The Black Walnut continues to send out new and vigorous shoots, ⅓ of the top is now covered with thrifty dense foliage. 12. Rain early a. m. 0.04; thunder storm 1 to 4 p. m. 1.50; thunder storm 7 to 9 p. m. 0.28. 14. The potato rot has made its appearance in several parts of the country since the last rains. The Newburyport Herald mentions that there is a slight touch of it in that vicinity, and on Long Island. It has also appeared in Montgomery and Bucks in Pennsylvania. It has not yet made its appearance around Albany. 16. Symphyluna officinale and Lilium canadense in flower. Circium arvense, Asclepias syriaca and Sambucus canadensis flowering. 20. Rain 5 to 6 p. m. 22. Heavy shower 4 to 6 p. m. Tem. rain 70°. Rained from 10 p. m. on the 22d till 8 a. m. 23d. 24. Slight shower during night. 27. Heavy thunder shower 5 to 7 p. m. 28. The Black Walnut continues to grow vigorously. 30. Rain 5 a. m. to 3 p. m. Occasional showers from 3 p. m. till dark. Wind shifted to the north at 9 p. m. force 5 with rain, which continued till 11 p. m. at a rapid rate.

Winds.—North 5 days, East 1½, South 12, West 7, Northeast 2, Southeast 1½, Southwest ½, Northwest ½.

Weather.—Clear ½ day, more or less cloudy the rest of the time. Warmest day 21st. Coldest day 7th. Highest temperature of air 88°. Lowest 58°.

AUGUST, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL. 1 foot below surface.		3 feet below surface.		2 feet below surface.		1 foot below surface.		OBSERVATIONS ON TREES. Horse Chestnut.		Black Walnut.		WEATHER. Air.				Direction of Wind.		Force of Wind.			Degree of cloudiness.				Inches rain.
	8 a.m.	3 p.m.	8 a.m.	3 p.m.	8 a.m.	3 p.m.	8 a.m.	3 p.m.	8 a.m.	3 p.m.	8 a.m.	3 p.m.	6 a.m.	8 a.m.	3 p.m.	9 p.m.	8 a.m.	3 p.m.	a.m.	p.m.	Mean	a.m.	p.m.		Mean	
1	68	68	66	66	67	67	61	61	68	69	66	68	61	68	80	70	W	W	1	2	1½	1	2	2	1½	....
2	68	68	66	66	67	67	61	61	67	69	64	68	61	69	80	71	NW	W	1	1	1	0	1	2	1	....
3	68	68	66	66	67	67	61	61	70	70	68	70	68	72	76	74	S	S	1	2	1½	3	4	3	3½	....
4	68	68	66	66	67	67	61	61	71	71	70	70	71	73	82	71	S	W	2	2	2	1	3	2	2	0.05
5	68	68	66	66	67	67	61	61	68	70	67	69	61	72	73	67	W	W	2	2	2	1	2	2	1½	....
6	68	68	66	66	67	66½	61	61	67	69	61	68	60	66	84	73	S	W	1	—	1	0	0	0	0	....
7	68	68	66	66	67	67	61	61	69	71	67	70	63	69	90	75	W	S		2	1½	0	0	0	0	....
8	68	68	66	66	67	67	61	61	70	71	68	70	67	72	84	74	S	S			1	1	2	2	1½	....
9	68	68	66	66	67	67	61	61	71	73	..	..	65	70	90	76	S	NE			1	0	0	0	0	....
10	68	68	66	66	67	67	61	61	72	73	..	..	68	70	86	78	S	S			1	0	1	1	1	....
11	68	68	66	66	68	68	63	63	73	74	..	..	76	78	90	78	S	S			1	2	2	2	2	....
12	68	68	66	66	68	68	62	62	73	75	..	..	70	72	93	76	S	SW	1	1	1	4	2	3	3	....
13	68	68	66	66	68	68	62	62	74	75	..	..	70	71	91	81	SE	S	1	1	1	1	1	1	1	....
14	68	68	66	66	68	68	62	62	74	75	..	..	76	78	86	80	S	S	2	2	2	1	2	2	1½	....
15	68	68	66	66	68	68	62	62	74	75	..	..	75	76	85	80	S	S	1	3	2	2	2	2	2	....
16	68	68	66	66	68	68	62	62	74	75	..	..	75	76	85	80	S	S	1	3	2	2	2	2	2	....
17	68	68	66	66	68	68	62	62	74	75	..	..	77	77	90	74	S	S	2	5	3½	2	2	2	2	3.04
18	68	68	66	66	68	68	63	63	..	..	..	..	65	67	70	65	N	N	1	2	1½	5	5	5	5	....
19	68	68	66	66	68	68	63	63	..	..	..	..	64	65	72	63	N	N	1	1	1	5	5	5	5	....
20	68	68	66	66	68	68	63	63	..	..	..	..	56	68	80	66	N	N	1	1	1	1	1	1	1	....
21	68	68	66	66	68	68	63	63	..	..	..	..	55	70	86	68	N	N	1	1	1	2	1	1½	1½	....
22	68	68	66	66	68	68	63	63	..	..	..	..	55	62	90	68	N	NW	1	1	1	1	1	1	1	....
23	68	68	66	66	68	68	63	63	..	..	..	..	58	66	82	60	N	N	1	1	1	1	2	1½	1½	....
24	68	68	66	66	68	68	63	63	..	..	..	..	57	62	85	70	W	SW	1	1	1	2	1	1½	1½	....
25	68	68	66	66	68	68	63	63	..	..	..	..	58	63	80	66	N	S	1	1	1	0	1	½	½	....
26	68	68	66	66	68	68	63	63	..	..	..	..	56	60	73	67	NE	W	1	1	1	3	4	3½	3½	....
27	68	68	66	66	68	68	62	62	..	..	..	..	58	63	85	71	NE	S	1	1	1	0	0	0	0	....
28	68	68	66	66	68	68	62	62	..	..	..	..	61	61	63	68	SE	SE	2	3	2½	4	6	5	5	0.70
29	68	68	66	66	68	68	62	62	..	..	..	..	68	63	81	69	N	NE	2	1	1½	5	1	3	3	....
30	68	68	66	66	68	68	62	62	..	..	..	..	61	66	89	70	N	NE	1	1	1	0	0	0	0	....
31	68	68	66	66	68	68	62	62	..	..	..	..	60	65	92	73	NE	SW	1	1	1	0	1	½	½	....
S.m.m.	68.06	67.32	67.32		63.62		71		68.11				71.32								1.3				1.33	0.05
16	68	68	66	66	68	68	62	62	74	75	..	..	75	76	85	80	S	S	1	3	2	2	2	2	2	....
17	68	68	66	66	68	68	62	62	74	75	..	..	77	77	90	74	S	S	2	5	3½	2	2	2	2	3.04
18	68	69	66	66	69	70	63	63	..	..	..	..	65	67	70	65	N	N	1	2	1½	5	5	5	5	....
19	68	66	66	67	67	69	63	63	..	..	..	..	64	65	72	63	N	N	1	1	1	5	5	5	5	....
20	68	67	66	65	67	67	63	63	..	..	..	..	56	68	80	66	N	N	1	1	1	1	1	1	1	....
21	68	67	66	66	67	67	63	63	..	..	..	..	55	70	86	68	N	N	1	1	1	2	1	1½	1½	....
22	68	67	66	66	67	66	63	63	..	..	..	..	55	62	90	68	N	NW	1	1	1	1	1	1	1	....
23	68	66	66	65	66	66	63	63	..	..	..	..	58	66	82	60	N	N	1	1	1	1	2	1½	1½	....
24	68	68	66	65	66	66	63	63	..	..	..	..	57	62	85	70	W	SW	1	1	1	2	1	1½	1½	....
25	68	66	66	65	66	66	63	63	..	..	..	..	58	63	80	66	N	S	1	1	1	0	1	½	½	....
26	68	66	66	65	66	66	63	63	..	..	..	..	56	60	73	67	NE	W	1	1	1	3	4	3½	3½	....
27	68	68	66	66	68	68	62	62	..	..	..	..	58	63	85	71	NE	S	1	1	1	0	0	0	0	....
28	68	68	66	66	68	68	62	62	..	..	..	..	61	61	63	68	SE	SE	2	3	2½	4	6	5	5	0.70
29	68	67	66	65	68	68	62	62	..	..	..	..	68	63	81	69	N	NE	2	1	1½	5	1	3	3	....
30	68	68	66	66	68	68	62	62	..	..	..	..	61	66	89	70	N	NE	1	1	1	0	0	0	0	....
31	68	68	66	66	68	68	62	62	..	..	..	..	60	65	92	73	NE	SW	1	1	1	0	1	½	½	....
S.m.m.	68.06	67.97	67.97		66.84		62.73						69.53								1.37				2.08	3.74
Mo. me	67.01	66.61	67.08		63.17								71.92								1.34				1.69	

OBSERVATIONS. 1. Heavy dew. The potato rot has made its appearance in the vicinity of Boston. 3. Heavy dew the 2d, 3d and 4th. 4. The Rumex crispus begins to ripen its seeds. Large numbers of caterpillars have commenced feeding upon the leaves of the Juglans nigra. 5. Rain 12 m. to 2 a. m. 6. The potato rot has made its appearance in the vicinity of the Helderbergh. 7. The Juglans nigra continues to grow vigorously, the caterpillars have nearly divested it of its leaves. It was cut down this morning. 8th, 9th and 10th smoky. 11. Heavy dews from the 6th to 11th. In Dr. Wendell's, Mr. Prentice's, Mr. Walsh's and other orchards around Albany, the pear, quince and apple trees have commenced dying. The leaves of the grape vine also are dying. 14. The potatoes are rotting in Maine, especially along the sea coast. 15. Warm and dry. The temperature of the air at 8 a. m. and 3 p. m. from the 1st to the 15th is 77.86°, being 3.56° higher than the corn plants, and 6.86° higher than that of the Horse Chestnut. 17. Rain from 5 p. m. to 12 m. with thunder. 18. Rain 12 m. at night to 9 a. m. The potatoes still continue to be affected on Long Island with the rot, especially the less hardy varieties. 21. The potato rot still continues in Maine. 22. The potatoes continue to rot slowly on the Helderberg. 24. The Pittsburgh Gazette says that ¼ of the potato crop in that vicinity is affected with the rot. From the 20th to the 22d warm. Hazy, smoky. 28. Rain 12 m. to 12 at night. 29. Rain 12 at night to 6 a. m.

Winds. North 7 days, East 0, South 11½, West 5, Northeast 3½, Southeast 1½ Southwest 1½ Northwest 1.

Weather. Fair 6½ days. More or less cloudy 24½ days. Rain on 5 days. Warmest day 12th. Coldest 26th. Highest temperature 92°. Lowest 55°.

SEPTEMBER, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOILS.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of Wind.		Force of Wind.			Degree of cloudiness.			Inches rain.
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a.m	3 p.m	9 p.m	8 a.m	3 p.m	a.m	p.m	Mean	a.m	p.m	Mean	
1	65	67	65	65	66	66	62	62	..	..	..	..	72	73	82	69	W	W	1	2	1½	1	2	1½	....
2	63	65	64	64½	66	66	62	62½	..	..	..	..	66	69	74	69	W	W	2	3	2½	4	3	3½	....
3	63	65	64	65	66	66	62	62	..	..	..	..	63	66	80	70	N	W	1	2	1½	4	3	3½	0.06
4	65	69	65	68	66	66	62½	62	..	..	..	..	65	69	88	72	W	NW	1	1	1	3	3	3	0.04
5	64	69	65½	67	66	66	62	62	..	..	..	..	62	66	81	73	W	SW	1	2	1½	1	4	2½	0.12
6	63	66	66	66	66	66	62	62	..	..	..	..	61	66	80	62	N	W	1	1	1	1	1	1	....
7	60	64	63	64½	66	65½	62	62	..	..	..	..	52	58	79	60	N	N	1	2	1½	0	2	1	....
8	58	64	62	65	64	64	62	62	..	..	..	..	50	54	80	65	E	S	1	1	1	0	1	½	....
9	62	65	63	65	64	64	62	62	..	..	..	..	62	64	78	61	SW	W	1	2	1½	2	2	2	....
10	57	64	62	62½	64	63½	62	62	..	..	..	..	48	56	81	63	N	NE	1	1	1	0	0	0	....
11	58	64	62	62	63½	63	62	62	..	..	..	..	56	59	76	66	S	S	2	2	2	1	3	2	....
12	59	59	63	60	63½	63	62	62	..	..	..	..	64	65	63	53	W	W	1	1	1	6	6	6	0.43
13	54	58	58	61	62½	62	62½	61½	..	..	..	..	45	51	68½	52	N	NE	2	2	2	0	1	½	....
14	54	55	57	58	61	60½	61½	61	..	..	..	..	45	49	53	57	W	S	1	3	2	4	5	4½	0.39
15	58	58	58	59	60	60	61	61	..	..	..	..	62	62	60	53	S	W	2	3	2½	5	6	5½	0.06
s.m.m.	61.83		45.		64.22		62.13								64.48						1.56		2.36	1.10	
16	50	56	56	59	60	59½	61	61	..	..	..	..	42	47	59	49	NW	N	2	1	1½	2	4	3	....
17	49	55	55	58	58	58	60	60	..	..	..	..	38	45	61	56	S	S	1	1	1	0	5	2½	0.60
18	54	58	58	58	58½	58½	60	60	..	..	..	..	54	55	64	59	N	N	1	2	1½	5	4	4½	0.15
19	54	54	58	58	59	59	60	60	..	..	..	..	53	53	54	65	S	S	2	2	2	1	1	1	....
20	59	62	60	61	59	59½	60	60	..	..	..	..	64	66	66	57	S	N	3	3	3	4	6	5	0.75
21	56	58	58	58	60	60	60	60	..	..	..	..	55	54	66	54	N	W	1	3	2	1	3	2	....
22	53	55	56	56	59	58½	59½	59½	..	..	..	..	45	46	50	41	N	N	2	2	2	3	6	4½	0.45
23	47	51	53	52½	56	57	59	59	..	..	..	..	39	44	53	51	W	W	2	2	2	2	4	3	....
24	52	53	53	53	56	56½	58	59	..	..	..	..	50	56	64	54	SW	W	1	2	1½	1	2	1½	0.02
25	51	55	53	54	56	56	58½	58	..	..	..	..	50	50	58	56	N	SW	1	2	1½	5	5	5	0.13
26	50	52	53	54	56	56	58	58	..	..	..	..	47	48	56	43	NW	N	3	3	3	3	1	2	....
27	44	49	50	51	54½	54½	57½	57½	..	..	..	..	34	37	56	47	N	N	1	1	1	0	1	½	....
28	46	50	52	54	54	54	57	57	..	..	..	..	40	42	56	47	S	W	2	2	2	5	1	3	....
29	45	48	51	52	53	53	57	56	..	..	..	..	48	50	51	62	S	W	3	3	3	5	4	4½	....
30	54	59	55	58	54	55½	56½	56½	..	..	..	..	61	63	68	62	S	SW	1	2	1½	3	3	3	0.02
S.M.me.,	52.66		54.6		56.95		58.82								53.33						1.9		2.97	2.12	
Mo.mean	57.25		49.8		60.59		60.48								58.92						1.73		2.67	3.22	

OBSERVATIONS.—1. Light dew. Smoky. 3. Light shower at 4 a. m. 4. Light shower early a. m. 5. Heavy dew. Smoky and fair in forenoon. Rain 6 to 10 p. m. 6. The rot is affecting the potato crop considerably in the central and western parts of the State. Many crops are almost entirely destroyed. It has not affected them much in this vicinity. 7. Heavy dew. Smoky. 8. Heavy dew. Cool night. Leaves of trees begin to turn slightly yellow. 9. Very smoky. Warm. 10. Light dew. Smoky. 11. Light dew. Smoky. Rain 6 p. m. to 12 at night. Rain 12 at night to 9 a. m. 13. Light dew. Total eclipse of moon last night. Air cool. 14. Heavy dew. Rain p. m. with thunder. 15. Rain early a. m. 16. Cool air. Smoky. Light dew. 17. Very foggy morning. Light frost on banks of river, not enough to injure vegetation. Rain 5 p. m. to 12 at night. 18. Rain 12 at night to 4 a. m. and at 6. p. m. 19. Smoky. 20. Rain during the day and night with thunder. 21. Smoky. 22. Light dew. Smoky. Rain 2 p. m. and during night. 23. Damp air. Smoky. 24. Rain a. m. Last night rain in Albany. A light snow storm on the Helderbergh. 25. Rain p. m. Smoky. 26. Smoky. Stiff N. breeze. Cool. 27. Light frost. Foggy. Pleasant autumn days. 28. Very smoky. 29. Light shower a. m. 30. Rain early a. m. Smoky. Warm day.

Winds.—North 8 days. East ½, South 6½, West 9½, Northeast 1, Southeast 0, Southwest 2, Northwest 1½.

Weather.—Warmest day, 4th. Coldest 27th. Highest range 88°. Lowest 34°. Rain on 15 days. Light frosts on the mornings of the 17th and 27th. Clear 3¼. More or less cloudy the remainder of the time.

OCTOBER, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of Wind.		Force of Wind.			Degree of cloudiness.			Inches rain.
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a.m	3 p.m	9 p.m	8 a.m	3 p.m	a.m	p.m	Mean	a.m	p.m	Mean	
1	56	58	58	60	55	56	56½	56½	56	59	..	..	62	58	62	56	N	N	1	1	1	5	5	5	0.25
2	54	55	56½	58	56	56	56½	56½	51	53	..	..	51	50	54	51	N	N	1	1	1	5	6	5½	0.96
3	52	54	54	54	56	56	56½	56½	50	52	..	..	50	48	53	52	W	SW	1	2	1½	6	6	6	0.65
4	53	56	53	54	55½	55½	56½	56½	53	56	..	..	51	53	60	59	N	N	1	1	1	5	4	4½	....
5	54	58	54	56	55½	55½	56½	56½	56	60	..	..	56	57	63	59	N	W	2	2	2	4	5	4½	....
6	52	56	54	55	56	56	56½	56½	56	60	..	..	51	51	65	51	N	N	2	2	2	3	1	2	....
7	50	56	53	55	55	56	56½	56½	51	61	..	..	45	47	66	60	N	S	1	1	1	1	1	1	....
8	53	51	54	53	56	56	56½	56½	58	57	..	..	58	60	55	44	W	NW	3	3	3	3	1	2	0.05
9	44	49	48½	50	53	54	56	56	46	56	..	..	38	38	58	41	S	S	1	3	2	0	1	½	....
10	47	50	52	51	54	54	56	56	51	56	..	..	49	49	60	48	SE	NW	2	2	2	5	2	3½	....
11	41	46	47	48	52	52	55½	55½	45	52	..	..	34	40	56	46	NW	NW	1	2	1½	1	0	½	....
12	44	48	45	48	51	51	55	55	45	57	..	..	36	44	63	53	W	W	1	1	1	0	1	½	....
13	44	47	46	48	52	51	54½	54½	46	51	..	..	36	42	55	45	N	W	1	1	1	1	1	1	....
14	44	47	45	47	50	51	54½	54	46	53	..	..	39	44	56	52	S	S	2	2	2	2	3	2½	....
15	46	49	46	48	50	51	54	54	49	57	..	..	43	46	68	54	N	N	1	1	1	0	0	0	....
Sm m.	50.47		53.03		60.72		55.82		53.37				51.42						1.53			2.6			1.91
16	47	53	48	51	52	51½	54	54	50	58	..	..	45	48	68	65	N	S	1	2	1	4	3	3½	0.06
17	53	57	53	54	52	52	54	54	61	63	..	..	61	63	63	52	S	W	3	3	3	1	5	3	5.33
18	42	41	51	51	52½	52½	54	54	46	45	..	..	41	42	41	40	N	N	3	3	3	6	7	6½	1.50
19	44	46	46	47	51	51	53½	53½	44	45	..	..	40	43	44	47	N	W	2	2	2	7	6	6½	0.05
20	45	46	46½	47	51½	51	53½	53	45	45	..	..	45	45	47	46	W	W	2	2	2	6	6	6	....
21	42	46	45½	46	49½	50	53	53	42	46	..	..	37	39	46	46	NE	NE	1	2	1½	6	7	6½	0.27
22	44	46	46	46	50	50	53	53	44	46	..	..	42	44	48	42	N	W	1	3	2	2	3	2½	....
23	39	43	44	44½	47	48	52½	52½	41	47	..	..	37	40	52	42	W	W	2	3	2½	0	1	½	....
24	40	40	43	43	46	46	52	52	42	44	..	..	37	40	43	49	N	W	1	2	1½	5	7	6	0.14
25	43	45	45	45	49	48	52	52	46	50	..	..	45	47	51	43	W	W	3	1	2	2	2	2	....
26	42	45	44½	45	48	48	52	52	44	49	..	..	41	43	50	48	SW	W	1	2	1½	4	4	4	....
27	42	46	44	44½	48½	48	52	51½	45	50	..	..	40	45	51	46	N	N	2	2	2	2	5	3½	....
28	40	46	44	44½	48	48	51½	51½	43	49	..	..	35	48	50	50	N	N	1	1	1	0	1	½	....
29	46	49	46	47	48½	49	51	51	51	55	..	..	50	51	59	57	N	S	2	2	2	5	5	5	....
30	52	53	48	50	49½	50	51½	51½	56	60	..	..	56	59	62	56	N	N	4	1	2½	4	2	3	....
31	49½	50	49½	50	50	50½	51½	51½	56	55	..	..	54	54	52	57	S	N	3	2	2½	6	5	5½	0.06
S.m.m.	45.7		46.86		49.58		52.5		48.84				46.6						2.72			4.03			4.03
Mo. me	48.09		49.95		55.15		54.16		51.11				49.01						2.13			3.32			2.16

OBSERVATIONS.—1. Smoky. Rain from 3 p. m. to 12 at night. 2. Rain from 12 at night to 12 m. and from 2 p. m to 12 at night. 3. Rain 12 at night to 6 a. m. and from 3 p. m. to 12 at night. 4. Rain from 12 at night to 8 a. m. The potato crop in this vicinity, except on the Helderbergh, has been injured but little as yet with the rot. The crop in Massachusetts and Connecticut, especially if late planted, are very good both in quality and quantity. The rot has appeared in Newfoundland, the eastern part of Maine, the northern part of Vermont, and in the Western States generally. In Western and Central New-York, although the vines are stout, yet in many cases but few potatoes are found under them. 5. Very smoky. 6. Very smoky. 7. Heavy dew with a dense fog. 8. Light dew. Rain early a. m. Leaves of Horse Chestnut tree begin to die. Fruit is falling. 9. Heavy frost. 10. Light shower in morning. 11. Light frost. Very smoky. 12. Light frost. Very smoky. 13. Heavy dew. Smoky. 14. Smoky. 15. Heavy dew. Smoky. 16. Smoky. Rain in evening. 17. Light dew. Rain from 9 p. m. till 12 at night. 18. Rain from 12 at night to 12 m. and from 4 p. m. to 6. p. m. 19. Light showers at intervals through the day. 20. Light showers from 12 at night to 8 a. m. 21. Light dew. Rain 3 p. m. and during night. 23. Light frost. 24. Rain from 8 a. m till night. 25. Smoky. 26. Smoky. 27. Heavy dew. Very smoky. 28. Heavy dew Smoky, foggy morning. 29. Leaves of Horse Chestnut ⅔ dead and ⅓ of them fallen off. 30. Smoky. Heavy dew. 31. Smoky. Light shower in afternoon.

Winds.—North 12¼ days, East 0, South 4¼, West 8¼, N.E. 1, S.E. ¼, S.W. 1, N.W. 2, Monthly force 2.13.

Weather.—Warmest d[illegible]
or less cloudy the remain[illegible]

NOVEMBER, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of wind.		Force of Wind.			Degree of cloudiness.			Inches rain.
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a. m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a m	3 p.m	9 p.m	a. m	p.m	a. m	p.m	Mean	a. m	p.m	Mean	
1	43	47	47	48	50	50	51	51	44	52	..	..	37	40	57	46	S	S	1	2	1½	0	0	0	....
2	42	45	46	47	51¼	49	52	51½	45½	58	..	..	40	42	56	42	W	W	2	3	2½	0	5	2½	....
3	43	45	46	46	47½	47½	51½	51	43	48	..	..	40	40	50	41	SE	W	2	3	2½	5	1	3	....
4	44	43	44	46	46	47½	51	51	42	43	..	..	36	41	46½	53	SW	SE	1	3	2	5	6	5¼	1.98
5	52	43	48	46	47	47	51	54	56	43	..	..	58	57	43	38	S	S	6	5	5½	7	7	7	
6	40	42	42	44	46	47	51	50	39	44	..	..	38	37	43	40	SW	SW	1	3	2	1	4	2½	....
7	38	40	41	44	45	47	50½	60½	39½	41	..	..	36	38	38	36	SW	SW	3	4	3½	3	6	4½	....
8	36	42	39	43	44	44	50	50	36	46	..	..	31	36	46	39	SE	SW	1	2	1½	1	3	2	....
9	36	37	40	41	45	44	50	50	37	36	..	..	37	37	32	28	SW	W	2	3	2½	6	4	5	....
10	32½	33	36	36¼	41½	43	49½	49½	31	33	..	..	21	22	32	22	N	W	2	3	2½	1	2	1½	....
11	32½	32½	36	36	40	42	49	49	31	32	..	..	19	22	29	30	NE	N	2	2	2	3	3	3	....
12	32½	32½	35	36	38½	38½	47	47	32½	33	..	..	28	30	31	33	N	N	1	1	1	6	6	6	0.23
13	32½	32	36	36	39½	39½	49½	48½	34	34½	..	..	33	37	40	33	N	N	1	1	1	5	4	4½	....
14	32½	32½	35½	37	39½	40	46½	47	33	33	..	..	25	30	31	34	NE	SE	1	2	1½	5	5	5	....
15	33	34	36	36	40	40	47	47	34	35	..	..	35	34	40	41	SE	S	1	1	1	5	5	5	0.03
S.m.m.	38¼		41		44½		49¾						36												
16	33	36	35	36	40	42	47	47	35	39	..	..	37	35	50	43	S	S	2	3	2½	1	1	1	....
17	35	38	36	37	40	42	47	46½	39	44	..	..	40	42	46	36	W	W	1	3	2	1	2	1½	....
18	36	39	40	42	39½	40	46½	47	36	42	..	..	31	34	44	33	N	W	1	3	2	1	2	1½	....
19	35	37	37	40	39	40	46	46½	35	36	..	..	30	32	35	30	N	N	3	3	3	4	5	4½	....
20	34	33	36	36	38	38	46	46	32	34	..	..	28	28	33	32	N	N	4	2	3	6	5	5½	0.14
21	33	33	35	36	40	39½	46	46	32	34	..	..	23	30	44	35	N	W	2	1	1½	0	1	½	.. .
22	34	36	38	39	38	38	45½	45½	36	38	..	..	37	38	40	39	NW	N	2	2	2	4	6	5	....
23	34	38	38	40	38	38½	45½	45	37	43½	..	..	37	38½	50	38	S	S	2	2	2	1	2	1½	....
24	36	37	38	40	40	38½	46	45	40	43	..	..	33	42	46	47	S	S	1	3	2	4	6	5	0.16
25	41	41	42	45	40	42	44	44	47	46	..	..	49	47	46	43	S	SW	1	3	2	2	3	2½	....
26	36	39	39	42	42	42	44	44	40	40	..	..	39	34	37	36	W	W	2	3	2½	6	6	6	0.07
27	33	34	37	37½	42	40	44	44	35	36½	..	..	31	29	36	33	NW	NW	2	3	2½	2	1	1½	....
28	33	36	36	41	38	38	44	44	32	34	..	..	25	26	37	36	S	S	3	3	3	1	3	2	....
29	34	38	39	42	38	38	44	44	35	44	..	..	34	36	45	46	S	W	3	4	3½	2	2	2	....
30	36	39	37	43	38½	39	43½	43½	43	46	..	..	43	43	50	36	S	W	4	3	3½	4	5	4½	....
S.m.m.,	36		38¼		39½		43¼						39												
Mo. mean,																									

Observations.—1. Heavy frost. Smoky. 2. Light frost. Very smoky. Leaves falling fast. 3. Smoky, 4. Light frost. Smoky. Rain from 12 m. till 12 at night. Tem. rain 46°. 5. Rain from 12 at night all day. Tem. 54°. a. m. and 43° p. m. 6. Heavy frost. Smoky. 7. Heavy frost. Slight snow p. m. 8. Heavy frost. Ice froze 1-16 inch during night. 9. Smoky. A little snow 2 p. m. Snow fell 10 inches deep in Buffalo. 10 soil froze from 1 to 2 inches deep. 11. Soil froze from 2 to 3 inches. Snow commenced at 9 p. m. and continued through the next day. 13. Snow 4 inches deep. Melting fast. 14. Smoky. 15. Smoky. Snow and rain a. m. 16. Froze slightly during night. Smoky. 17. Smoky. 18. Froze slightly during night. 19. Froze slightly during night. Smoky. 20. Snow from 8 a. m. to 2 p. m. 21. Snow 2 inches deep. Smoky. 22. Smoky. 23. Smoky. 24. Rain p. m. 25. Smoky. 26. Snow 7 a. m. to 9 a. m. 28. Soil froze ½ inch deep during night. 29. Soil froze 1½ inches during night. 30. Smoky. 31. Smoky.

Winds.—North 6½, East ½, South 8, West 6½, Northeast 1, Southeast 3. Northwest 1½, Southwest 4,

Weather.—Clear 1¼ days. More or less cloudy the rest of time. Rain on 4 days. Snow on 6 days. Warmest day 5th. Coldest day 10th. Highest temperature 58 degrees. Lowest temperature 19 degrees.

OCTOBER, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of Wind.		Force of Wind.			Degree of cloudiness.			Inches rain.
	8 a. m	3 p. m	8 a. m	3 p. m	8 a. m	3 p. m	8 a. m	3 p. m	8 a. m	3 p. m	8 a. m	3 p. m	6 a. m	8 a. m	3 p. m	9 p. m	8 a. m	3 p. m	a. m	p. m	Mean	a. m	p. m	Mean	
1	56	58	58	60	55	56	56½	56½	56	59	..	..	62	58	62	56	N	N	1	1	1	5	5	5	0.25
2	54	55	56½	58	56	56	56½	56½	51	53	..	..	51	50	54	51	N	N	1	1	1	5	6	5½	0.96
3	52	54	54	54	56	56	56½	56½	50	52	..	..	50	48	53	52	W	SW	1	2	1½	6	6	6	0.65
4	53	56	53	54	55½	55½	56½	56½	53	56	..	..	51	53	60	59	N	N	1	1	1	5	4	4½	....
5	54	58	54	56	55½	55½	56½	56½	56	60	..	..	56	57	63	59	N	W	2	2	2	4	5	4½	....
6	52	56	54	55	56	56	56½	56½	56	60	..	..	51	51	65	51	N	N	2	2	2	3	1	2	....
7	50	56	53	55	55	56	56½	56½	51	61	..	..	45	47	66	60	N	S	1	1	1	1	1	1	....
8	53	51	54	53	56	56	56½	56½	58	57	..	..	58	60	55	44	W	NW	3	3	3	3	2	2	0.05
9	44	49	48½	50	53	54	56	56	46	56	..	..	38	38	58	41	S	S	1	3	2	0	1	½	....
10	47	50	52	51	54	54	56	56	51	56	..	..	49	49	60	48	SE	NW	2	2	2½	5	2	3	....
11	41	46	47	48	52	52	55½	55½	45	52	..	..	34	40	56	46	NW	NW	1	2	1½	1	0	½	....
12	41	48	45	48	51	51	55	55	45	57	..	..	36	44	63	53	W	W	1	1	1	0	1	½	....
13	44	47	46	48	52	51	54½	54½	46	51	..	..	36	42	55	45	N	W	1	1	1	1	1	1	....
14	44	47	45	47	50	51	54½	54	46	53	..	..	39	44	56	52	S	S	2	2	2	2	3	2½	....
15	46	49	46	48	50	51	54	54	49	57	..	..	43	46	68	54	N	N	1	1	1	0	0	0	....
Sm m.	50.47		53.03		60.72		55.82		53.37				51.42						1.53			2.6			1.91
16	47	53	48	51	52	51½	54	54	50	58	..	..	45	48	68	65	N	S	1	2	1	4	3	3½	0.06
17	53	57	53	54	52	52	54	54	61	63	..	..	61	63	63	52	S	W	3	3	3	1	5	3	5.33
18	42	41	51	51	52½	52½	54	54	46	45	..	..	41	42	41	40	N	N	3	3	3	6	7	6½	1.50
19	44	46	46	47	51	51	53½	53½	44	45	..	..	40	43	44	47	N	W	2	2	2	7	6	6½	0.05
20	45	46	46½	47	51½	51	53½	53	45	45	..	..	45	45	47	46	W	W	2	2	2	6	6	6	....
21	42	46	45½	46	49½	50	53	53	42	46	..	..	37	39	46	46	NE	NE	1	2	1½	6	7	6½	0.27
22	44	46	46	46	50	50	53	53	44	46	..	..	42	44	48	42	N	W	1	3	2	2	3	2½	....
23	39	43	44	44½	47	48	52½	52½	41	47	..	..	37	40	52	42	W	W	2	3	2½	0	1	½	....
24	40	40	43	43	46	46	52	52	42	44	..	..	37	40	43	49	N	W	1	2	1½	5	7	6	0.14
25	43	45	45	45	49	48	52	52	46	50	..	..	45	47	51	43	W	W	3	1	2	2	2	2	....
26	42	45	44½	45	48	48	52	52	44	49	..	..	41	43	50	48	SW	W	1	2	1½	4	4	4	....
27	42	46	44	44½	48½	48	52	51½	45	50	..	..	40	45	51	46	N	N	2	2	2	2	5	3½	....
28	40	46	44	44½	48	48	51½	51½	43	49	..	..	35	48	50	50	N	N	1	1	1	0	1	½	....
29	46	49	46	47	48½	49	51	51	51	55	..	..	50	51	59	57	N	S	2	2	2	5	5	5	....
30	52	53	48	50	49½	50	51½	51½	56	60	..	..	56	59	62	56	N	N	4	1	2½	4	2	3	....
31	49¼	50	49¼	50	50	50½	51½	51½	56	59	..	..	54	54	52	57	S	N	3	2	2½	6	5	5½	0.03
S.m.m.	45.7		46.86		49.58		52.5		48.84				46.6						2.72			4.03			4.03
Mo. me	48.09		49.95		55.15		54.16		51.11				49.01						2.13			3.32			2.16

OBSERVATIONS.—1. Smoky. Rain from 3 p. m. to 12 at night. 2. Rain from 12 at night to 12 m. and from 2 p. m to 12 at night. 3. Rain 12 at night to 6 a. m. and from 3 p. m. to 12 at night. 4. Rain from 12 at night to 8 a. m. The potato crop in this vicinity, except on the Helderbergh, has been injured but little as yet with the rot. The crop in Massachusetts and Connecticut, especially if late planted, are very good both in quality and quantity. The rot has appeared in Newfoundland, the eastern part of Maine, the northern part of Vermont, and in the Western States generally. In Western and Central New-York, although the vines are stout, yet in many cases but few potatoes are found under them. 5. Very smoky. 6. Very smoky. 7. Heavy dew with a dense fog. 8. Light dew. Rain early a. m. Leaves of Horse Chestnut tree begin to die. Fruit is falling. 9. Heavy frost. 10. Light shower in morning. 11 Light frost. Very smoky. 12. Light frost. Very smoky. 13. Heavy dew. Smoky. 14. Smoky. 15 Heavy dew. Smoky. 16. Smoky. Rain in evening. 17. Light dew. Rain from 9 p. m. till 12 at night. 18. Rain from 12 at night to 12 m. and from 4 p. m. to 6. p. m. 19. Light showers at intervals through the day. 20. Light showers from 12 at night to 8 a. m. 21. Light dew. Rain 3 p. m. and during night. 23. Light frost. 24. Rain from 8 a. m till night. 25. Smoky. 26. Smoky. 27. Heavy dew. Very smoky. 28. Heavy dew Smoky, foggy morning. 29. Leaves of Horse Chestnut ¾ dead and ¼ of them fallen off. 30. Smoky. Heavy dew 3.. Smoky. Light shower in afternoon.

Winds.—North 12½ days, East 0, South 4½, West 8½, N.E. 1, S.E. ½, S.W. 1, N.W. 2, Monthly force 2.13.

Weather.—Warmest day 17th. Coldest 30. Highest range 38°. Lowest 31°. Rain on 13 days. Clear 3½ days. More or less cloudy the remainder of the time. Frost on the mornings of the 9th, 11th, 12th and 23d.

NOVEMBER, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOIL.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of wind.		Force of Wind.			Degree of cloudiness.			Inches rain.
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a. m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a.m	3 p.m	9 p.m	a. m	p.m	a. m	p.m	Mean	a. m	p.m	Mean	
1	43	47	47	48	50	50	51	51	44	52	..	..	37	40	57	46	S	S	1	2	1½	0	0	0	....
2	42	45	46	47	51½	49	52	51½	45½	58	..	..	40	42	56	42	W	W	2	3	2½	0	5	2½	....
3	43	45	46	46	47½	47½	51½	51	43	48	..	..	40	40	50	41	SE	W	2	3	2½	0	5	3	....
4	44	43	44	46	46	47½	51	51	42	43	..	..	36	41	46½	53	SW	SE	1	3	2	5	6	5½	
5	52	43	48	46	47	47	51	54	56	43	..	..	58	57	43	38	S	S	6	5	5½	7	7	7	1.98
6	40	42	42	44	46	47	51	50	39	44	..	..	38	37	43	40	SW	SW	1	3	2	1	4	2½	....
7	38	40	41	44	45	47	50½	60½	39½	41	..	..	36	38	38	36	SW	SW	3	4	3½	1	6	4½	....
8	36	42	39	43	44	44	50	50	36	46	..	..	31	36	46	39	SE	SW	1	2	1½	1	3	2	....
9	36	37	40	41	45	44	50	50	37	36	..	..	37	37	32	28	SW	W	2	3	2½	1	6	5	....
10	32½	33	36	36½	41½	43	49½	49½	31	33	..	..	21	22	32	22	N	W	2	3	2½	1	2	1½	....
11	32½	32½	36	36	40	42	49	49	31	32	..	..	19	22	29	30	NE	N	2	2	2	1	3	3	....
12	32½	32½	35	36	38½	38½	47	47	32½	33	..	..	28	30	31	33	N	N	1	1	1	1	6	6	0.23
13	32½	32	36	36	39½	39½	49½	48½	34	34½	..	..	33	37	40	33	N	N	1	1	1	5	4	4½	....
14	32½	32½	35½	37	39	40	46	47	33	33	..	..	25	30	31	34	NE	SE	1	2	1½	5	5	5	....
15	33	34	36	36	40	40	47	47	34	35	..	..	35	34	40	41	SE	S	1	1	1	5	5	5	0.03
S.m.m.	38½		41		44½		49½						36												
16	33	36	35	36	40	42	47	47	35	39	..	..	37	35	50	43	S	S	2	3	2½	1	1	1	....
17	35	38	36	37	40	42	47	46½	39	44	..	..	40	42	46	36	W	W	1	3	2	1	2	1½	....
18	36	39	40	42	39½	40	46½	47	36	42	..	..	31	34	44	33	N	W	1	3	2	1	2	1½	....
19	35	37	37	40	39	40	46	46½	35	36	..	..	30	32	35	30	N	N	3	3	3	4	5	4½	....
20	34	33	36	36	38	38	46	46	32	34	..	..	28	28	33	32	N	N	4	2	3	6	5	5½	0.14
21	33	33	35	36	40	39½	46	46	32	34	..	..	23	30	44	35	N	W	2	1	1½	0	1	½	.. .
22	34	36	38	39	38	38	45½	45½	36	38	..	..	37	38	40	39	NW	N	2	2	2	4	6	5	....
23	34	38	38	40	38	38½	45½	45	37	43½	..	..	37	38½	50	38	S	S	2	2	2	1	2	1½	....
24	36	37	38	40	40	38½	46	45	40	43	..	..	33	42	46	47	S	S	1	3	2	4	6	5	0.16
25	41	41	42	45	40	42	44	44	47	46	..	..	49	47	46	43	S	SW	1	3	2	2	3	2½	....
26	36	39	39	42	42	42	44	44	40	40	..	..	39	34	37	36	W	W	2	3	2½	6	6	6	0.07
27	33	34	37	37½	42	40	44	44	35	36½	..	..	31	29	36	33	NW	NW	2	3	2½	2	1	1½	....
28	33	36	36	41	38	38	44	44	32	34	..	..	25	26	37	36	S	S	3	3	3	1	3	2	....
29	34	38	39	42	38	38	44	44	35	44	..	..	34	36	45	46	S	W	3	4	3½	2	2	2	....
30	36	39	37	43	38½	39	43½	43½	43	46	..	..	43	43	50	36	S	W	4	3	3½	4	5	4½	....
S.m.m., 36			38½		39½		43½						39												
Mo. mean,																									

Observations.—1. Heavy frost. Smoky. 2. Light frost. Very smoky. Leaves falling fast. 3. Smoky, 4. Light frost. Smoky. Rain from 12 m. till 12 at night. Tem. rain 46°. 5. Rain from 12 at night all day. Tem. 54°. a. m. and 43° p. m. 6. Heavy frost. Smoky. 7. Heavy frost. Slight snow p. m. 8. Heavy frost. Ice froze 1-16 inch during night. 9. Smoky. A little snow 2 p. m. Snow fell 10 inches deep in Buffalo. 10 soil froze from 1 to 2 inches deep. 11. Soil froze from 2 to 3 inches. Snow commenced at 9 p. m. and continued through the next day. 13. Snow 4 inches deep. Melting fast. 14. Smoky. 15. Smoky. Snow and rain a. m. 16. Froze slightly during night. Smoky. 17. Smoky. 18. Froze slightly during night. 19. Froze slightly during night. Smoky. 20. Snow from 8 a. m. to 2 p. m. 21. Snow 2 inches deep. Smoky. 22. Smoky. 23. Smoky. 24. Rain p. m. 25. Smoky. 26. Snow 7 a. m. to 9 a. m. 28. Soil froze ¼ inch deep during night. 29. Soil froze 1½ inches during night. 30. Smoky. 31. Smoky.

Winds.—North 6½, East ½, South 8, West 6½, Northeast 1, Southeast 3. Northwest 1½, Southwest 4,

Weather.—Clear 1½ days. More or less cloudy the rest of time. Rain on 4 days. Snow on 6 days. Warmest day 5th. Coldest day 10th. Highest temperature 58 degrees. Lowest temperature 19 degrees.

DECEMBER, 1848.

DAY OF MONTH.	OBSERVATIONS ON SOILS.								OBSERVATIONS ON TREES.				WEATHER.												
	4 inc. below surface.		9 inc. below surface.		2 feet below surface.		4 feet below surface.		Horse Chestnut.		Black Walnut.		Air.				Direction of Wind.		Force of Wind.			Degree of Cloudiness.			Inches rain.
	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	8 a.m	3 p.m	6 a.m	8 a.m	3 p.m	9 p.m	a.m	p.m	a.m	p.m	Mean	a.m	p.m	Mean	
1	34	40	40	39	38	40	43½	43	38	39	..	..	..	34	38	..	W	N	3	2	2½	5	4	4½	....
2	37	45	41	42	39½	38½	43½	43½	42	38	..	..	..	44	48	..	S	W	4	3	3½	7	7	7	....
3	36	40	38	41	42	42	44	41	40	38	..	..	..	42	41	..	W	W	2	2	2	2	2	2	....
4	35	38	38	40	40	40	43½	43½	38	41	..	..	..	34	45	..	NW	NE	2	2	2	6	6	3	....
5	34	38	38	39	39	39½	43½	43½	39	40	..	..	..	37	37	..	NE	N	2	2	2	6	7	6½	....
6	36	36	39	38	40	39	43½	43½	37	36	..	..	..	34	34	..	N	NE	2	2	2	6	7	6½	....
7	33	36	30	37	40	38½	43½	43½	34	38	..	..	..	34	38	..	S	S	2	2	2	7	6	6½	....
8	38	38	38	39	40	39	43½	43½	44	46	..	..	..	43	54	..	S	S	2	2	2	6	6	6	....
9	38	39	38	42	40	42	43½	43½	43	44	..	..	..	42	44	..	W	W	2	2	2	1	4	3½	....
10	38	42	40	42	40	40	43½	43½	40	45	..	..	..	40	47	..	S	S	3	2	2½	7	6	6½	....
11	39	40	42	43	40	40	44	43½	41	40	..	..	..	40	38	..	NW	NW	2	2	2	5	4	4½	....
12	37	37	39	40	40	40	43½	43½	37	36	..	..	..	34	32	..	W	SW	2	2	2	5	7	6	....
13	33	34	36	35½	38	39	43	43½	33	33	..	..	..	25	30	..	W	W	2	2	2	6	4	5	....
14	37	38	38	38	38	39	43½	43½	37	42	..	..	..	39	44	..	SE	S	1	2	1½	6	6	6	....
15	40	40	40	40	40	40	43	43½	44	43	..	..	..	43	41	..	S	W	1	2	1½	7	2	4½	....
S.mm.	37½		39		40		43½							39½											
16	34	35	36	38	39	29	43	43	33	37	..	..	..	28	37	..	SW	S	2	3	2½	5	6	5½	....
17	38	39	38	40	39½	40	43	43	41	42	..	..	..	41	46	..	N	N	1	1	1	3	2	2½	....
18	33	37	37	38	39	39	43	43	41	43	..	..	..	40	47	..	W	NE	1	2	1½	3	2	2½	....
19	37	42	41	44	39	39	43	43	43	50	..	..	..	42½	62	..	S	SW	2	2	2	4	4	4	....
20	38	38	40	42	40	39	43	43	40	40	..	..	..	36	34	..	N	NE	3	2	2½	5	5	5	....
21	35	34	39	36	38	38	43	43	33	33	..	..	..	26	22	..	N	NE	2	3	2½	5	7	6	....
22	33	33	36	36	37	37½	42½	42½	31	29	..	..	..	13	18	..	N	N	1	4	2½	7	7	7	....
23	33	33	35	35	38	37	42	42	24	26	..	..	..	10	15	..	N	N	1	2	1½	1	1	1	....
24	33	33	35	35	38	38	42	42	24	28	..	..	..	10	28	..	S	S	2	5	3½	6	7	6½	....
25	33	33	35	35	37	37	42	42	32	33	..	..	..	35	38	..	S	S	2	2	2	6	6	6	....
26	33	33	35	35	36½	34	41½	41½	31	21	..	..	..	29	33	..	NW	S	4	2	3	1	3	2	....
27	33	33	35	35	34	34	41½	41½	21	22	..	..	..	13	20	..	N	N	2	2	2	5	7	6	....
28	33	33	35	35	35	35	41	41	23	27	..	..	..	31	29	..	NW	N	3	2	2½	1	1	1	....
29	33	33	35	35	35	35	41	41	..	..	..	..	..	..	..	..	....	....	..	..	..	..	..	..	....
30	33	33	35	34	35	35	40	40	27	31	..	..	..	28	32	..	W	W	2	1	1½	7	1	4	....
31	33	33	34	34	35	35	40	40	32	33	..	..	..	32	35	..	W	S	2	1	1½	4	4	4	....
S.m.m	34		35½		37		41½							30¼											
M.me.	35½		34½		38½		42½							35											

OBSERVATIONS.—2. Rainy. Heavy showers a. m. 3. Smoky. 4. Smoky. 5. Rain during night and from 9 a.m. to 12 at night. 6. Rain early a. m. till 12 at night. 7. Rain early a. m. all day. 8. Rain early a. m. P. m. pleasant. Smoky. 9. Smoky. 10. Rained all night and most of day. 11. Smoky. 12. Commenced snowing 2 p. m. and continued at intervals through the night. 13. Smoky. 14. Smoky. Rain from 8 a. m. to 10 a. m. 16. Soil froze ¼ inch deep. 17. Rain during night. Day pleasant. 18. Smoky. 19. Smoky. 20. Smoky. 21. Snow fell ½ inch deep last night. Commenced again 11 a. m. and continued through the day. 22. Snow 3 p. m. 12 inches deep. 23. Smoky, pleasant. 24. Hail and snow from 8 a. m. to 3 p. m. 25. Rain from 11 a. m. through the day. 26. Smoky. 27. Snow commenced falling 8 a. m. at 3. p. m. it had fallen 3 inches deep. 28. 8 inches of snow has fallen since 8 a. m. yesterday. 30, 4 inches of snow fell during night. 31. Pleasant. Thaws in sun.

OBSERVATIONS

ON THE TEMPERATURE ON THE SOIL, AT HOOSIC FALLS, RENSSELAER COUNTY, NEW-YORK.

By L. C. BALL, Esq.

These observations were made daily during the past summer. I have selected only the extremes of each half month as reported. *Temperature* of the soil 4 inches below the surface.

	FIRST HALF.		SECOND HALF.	
	Air.	Soil.	Air.	Soil.
MAY.				
Highest,	....	....	91	78
Lowest,	....	....	54	52
Mean,	....	....	76¼	67⅞
JUNE.				
Highest,	85	80	101	90
Lowest,	58	55	72	72
Mean,	72½	65⅜	85⅜	80½
JULY.				
Highest,	94	84	100	81
Lowest,	72	66	70	63
Mean,	78¼	76	80	75
AUGUST.				
Highest,	100	87	109	82
Lowest,	55	71	60	63
Mean,	89⅛	78¼	80⅜	72¼
SEPTEMBER.				
Highest,	86	89	72	64
Lowest,	51	49	50	50
Mean,	70⅜	67	62	58⅜

NOTE.—The observations were continued through October and a part of November, but being taken at the depth of one foot, and a change also being made as to the position of the air thermometer, they are omitted, as they do not correspond with those made in the preceding months.

OBSERVATIONS.

ON THE TEMPERATURE OF THE SOIL, MADE AT SCOTT, CORTLAND COUNTY, NEW-YORK.

By Mr. C. B. Salisbury.

MARCH, 1848.

DAY OF MONTH.	OBSERVATIONS AT 5 A. M. OR BEFORE SUNRISE.										OBSERVATIONS AT 3 P. M.								
	Temperature of air in shade.	Tem. of naked soil 2 in. below surface.	Tem. soil 2 feet below the surface.	Tem. soil 4 feet below the surface.	Temperature dew,	Temperature rain.	Depth rain fallen since yesterday 3 p. m.	Degree of cloudiness,	Course of wind.	Force of wind.	Temperature of air in shade.	Tem. loose naked soil 2 inches below surface.	Tem. soil 2 feet below the surface.	Tem. soil 4 feet below the surface.	Tem. rain.	Depth rain fallen since this morning 5 a. m.	Degree of cloudiness.	Course of wind.	force of wind.
1	..	....	..	..	....	....	....	..	....	..	..	..	..	..	..	....	..	....	..
2	..	....	..	..	....	....	....	..	....	..	..	..	..	..	..	....	..	....	..
3	..	....	..	..	....	....	....	..	....	..	32	32	31°	33°	31	....	5	NW	4
4	16	....	31	33	....	....	....	0	S	2	26	21	31	33	32	....	3	NW	5
5	12	....	31	32	....	....	....	3	NW	5	14	13	32	33	32	....	2	NW	3
6	16	....	31	32	....	....	....	3	S	2	28	22	33	34	32½	....	0	NW	2
7	20	....	32	33	....	....	....	0	S	2	48	34	34	35	33	....	0	S	2
8	40	....	32	33	....	....	....	0	S	2	51	40½	32	33	32½	....	3	S	3
9	32	....	32	32	....	....	....	4	NW	2	38	35	32	33	..	....	4	NW	2
10	20	....	31	34	....	....	....	4	N	3	20	20	32	33	..	....	4	N	2
11	18	....	32	34	....	....	....	3	NW	2	19	18	32	34	..	....	0	NW	1
12	24	....	32	34	....	....	....	4	S	4	36	30	32	34	..	....	6	S	6
13	24	....	32	34	....	....	....	5	NW	4	27	25	32	34	..	....	6	N	3
14	11	....	32	34	....	....	....	3	NW	2	11	11	32	34	..	....	3	NW	3
15	0	....	32	34	....	....	....	4	NW	4	3	1½	32	34	..	....	2	NW	2
16	3	....	32	34	....	....	....	2	....	1	22	12	32	34	..	....	3	N	1
17	4	....	32	34	....	....	....	1	N	1	28	16	32	34	..	....	0	NW	1
18	14	....	32	34	....	....	....	3	N	1	35	24½	33	35	..	....	0	NW	1
19	15	....	33	35	....	....	....	2	NW	1	38	26	34	35	..	....	6	S	3
20	29	....	34	35	....	froz	....	3	S	3	38	38½	34	35	..	....	5	S	3
21	44	....	33	35	....	40	....	4	NW	4	44	44	33	35	..	....	5	NW	3
22	31	....	33	35	....	....	....	4	NW	2	33	32	33	35	..	....	4	NW	2
23	40	....	33	35	....	....	⅛in	4	NW	2	40	40	34	35	..	....	3	N	2
24	25	....	34	35	....	....	⅛ "	1	NW	1	40	32½	34	35	..	....	1	NW	1
25	28	....	34	35	....	....	Sn 1	2	S	3	54	41	34	35	..	....	4	S	4
26	42	....	34	35	....	42	⅛in	5	S	3	50	45	34	35	48	⅛ in	4	SE	2
27	33	....	34	35	....	32	⅛ "	4	NW	2	35	34	34	35	..	....	6	NW	2
28	32	....	34	35	....	33	⅛ "	4	NW	1	35	37½	34	35	..	....	4	NW	2
29	33	....	34	35	....	34	⅛ "	3	S	2	54	43½	34	35	..	....	1	S	1
30	30	....	34	35	....	....	....	1	S	1	61	45½	34	35	..	....	2	S	2
31	46	....	34	35	....	....	....	2	S	3	66	56	34	35	..	....	2	S	6

Remarks at 5 A. M.—4. Snow 8. inches deep.. 5. Much drifted. 6. Snowing. 9. Fell 1 inch snow. 10. Snow fell 6 inches. 11. Snow fell 4 inches. 12. Snowing a little. 13. Snowing. 15. 2 inches snow fell. 18. Hazy. 19. Hazy. 20. Foggy. 21. Some foggy. Sap runs. 23. Snowing. 27. Foggy. 28. Foggy.

Remarks at 3 P. M.—3. Snowing. 4. 4 more inches of snow. 5. Ground is frozen about 8 inches, bare. 8. Smoky. Sap runs. 9. Snowing. 12. Raining. 13. Snowing a little. 14. Snowing a little. Sleighing. 19. Raining. Turned to snow. 20. Rain. Thunder and lightning at night. 21. Little rain. Sap runs. 26. Foggy. 27. Lowry. 31. Mud and snow mostly disappeared.

APRIL, 1848.

DAY OF MONTH.	OBSERVATIONS AT 5 A. M. OR BEFORE SUNRISE.										OBSERVATIONS AT 3 P. M.								
	Temperature of air in shade.	Tem. loose naked soil 2 inches below surface.	Tem of soil 9 feet below surface.	Tem of soil 4 feet below surface.	Tem. dew.	Tem. rain.	Depth rain fallen since yesterday, 3 p. m.	Degree of cloudiness.	Course of wind.	Force of wind.	Tem. air in shade.	Tem. loose naked soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. rain.	Depth rain fallen since morning, 5 a. m.	Degree of cloudiness.	Course wind.	Force wind.
1	33	..	35	36	....	33	sno in	4	NW	2	42	..	35	36	....	....	1	NW	2
2	30	..	36	38	....	....	....	2	NW	2	40	..	36	38	....	....	2	S	2
3	30	..	36	37	....	....	....	1	S	4	49	..	37	38	....	....	3	S	3
4	40	..	37	38	....	....	....	5	S	4	40	..	37	38	....	....	4	S	2
5	35	..	38	37	....	36	¼	4	NW	2	38	..	49	38	....	....	3	NW	2
6	24	..	39	38	....	....	....	1	W	1	44	48	39	38	....	....	1	NW	3
7	27	..	39	38	....	....	....	1	NW	3	54	..	39	38	....	....	1	NW	3
8	22	..	39	38	....	....	....	1	NW	1	56	..	39	38	....	....	1	NW	1
9	36	40	39	38	....	....	....	2	NW	3	66	62	39	38	....	....	3	NW	2
10	35	40	39	38	....	....	....	1	N	1	65	..	39	38	....	....	2	N	1
11	39	..	39	38	....	....	....	2	S	1	66	..	40	39	....	....	3	S	2
12	44	47	40	39	....	48	⅛ in	3	S	1	39	..	42	40	....	....	3	N	2
13	40	46	43	40	....	....	....	5	NW	3	44	..	42	40	....	....	5	NW	3
14	33	..	43	40	....	....	....	5	NW	4	38	..	42	40	....	....	4	NW	4
15	28	..	42	40	....	....	¼ in	2	NW	3	59	46	42	40	....	....	3	NW	5
16	38	40	42	40	....	....	s &r	2	NW	2	54	61	42	40	....	....	3	NW	2
17	30	33	42	41	....	....	....	1	NW	2	41	35	42	41	....	....	2	NW	3
18	32	38	42	41	....	....	....	3	S	2	52	53	42	41	....	....	2	S	5
19	28	40	42	44	....	....	....	2	NW	5	37	51	42	46	....	....	1	NW	5
20	29	37	42	40	....	....	....	2	NW	1	50	53	42	40	....	....	2	SW	2
21	36	40	42	40	....	....	....	2	SW	1	58	55	42	41	....	....	2	SE	2
22	44	49	42	41	....	....	....	2	S	1	58	52	42	41	50	1–16	6	NW	2
23	25	36	42	41	....	....	....	2	S	1	65	56	42	41	....	in	4	S	4
24	32	34	42	41	....	....	....	4	NW	3	41	35	42	41	froz	¼	3	NW	4
25	26	32	43	42	....	....	....	1	S	2	51	45	43	42	....	....	1	SW	2
26	40	42	43	42	....	....	....	1	SW	2	51	46	43	42	....	....	2	NW	2
27	28	35	43	42	....	....	....	1	S	1	56	58	43	42	....	....	1	S	2
28	42	44	43	42	....	....	....	2	S	1	69	65	43	42	....	....	2	S	4
29	30	34	44	42	....	....	....	1	NW	2	62	63	44	42	....	....	1	NW	2
30	54	52	44	42	....	....	....	3	S	4	41	45	44	42	42	⅓	3	NW	4

REMARKS AT 5 A. M.—1. Sprinkle of snow. 14. Snow, rain, hail. 20. Smoky. 21. Smoky. 22. Smoky. 23. heavy frost. 24. Foggy on streams. 26. Hazy. 27. Heavy frost. 28. Smoky.

REMARKS AT 3 P. M.—13. Some show. 17. Hazy. 18. Smoky. 22. Some rain. 23. Smoky. 28. Smoky.

MAY, 1848.

DAY OF MONTH.	OBSERVATIONS AT 5 A. M., OR BEFORE SUNRISE.										OBSERVATIONS AT 3 P. M.								
	Temperature of air in shade.	Tem. loose naked soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. dew.	Tem. rain.	Depth rain fallen since yesterday, 3 p. m.	Degree of cloudiness.	Course wind.	Force wind.	Tem. air in shade.	Tem. loose soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. rain.	Depth rain fallen since morning, 5 a. m.	Degree of cloudiness.	Course wind.	Force wind.
1	36	42	44	42	....	..	....	3	S	2	55	52	44	42	..	....	5	S	5
2	40	43	45	43	....	45	4	4	S	3	61	55	46	43	..	....	3	NE	3
3	38	44	46	43	....	..	....	4	NE	3	67	61	47	43	..	....	2	NW	3
4	40	48	48	43	....	..	....	1	S	1	78	72	50	44	..	....	2	S	2
5	55	54	50	44	....	43	4	3	S	3	82	73	50	44	..	....	3	SW	4
6	51	54	50	44	50-h	..	....	1	S	1	80	82	50	54	..	....	2	S	2
7	54	55	51	44	51-h	..	....	2	S	1	66	68	51	44	69	3	9	NW	8
8	40	44	51	44	46-h	..	....	2	NW	2	56	64	51	44	..	....	2	NW	2
9	44	48	51	44	....	45	4	4	NW	1	57	63	51	44	49	....	..	....	..
10	49	50	51	44	....	..	....	3	S	2	48	53	51	44	..	....	5	S	3
11	48	50	51	44	....	48	7	6	NE	1	50	50	51	44	50	7-16	6	NE	2
12	53	54	49	46	....	55	....	5	N	1	60	66	49	46	..	....	3	N	1
13	54	55	49	46	54	..	....	3	N	2	58	65	49	46	5	....	3	N	2
14	56	55	49	46	56	..	....	2	N	3	54	65	49	46	..	....	2	N	1
15	57	56	49	46	....	..	....	1	N	1	..	..	..	..	..	....	2	N	1
16	53	54	49	46	....	55	....	5	N	1	60	66	49	46	..	....	3	N	1
17	40	42	49	46	42-h	..	....	1	N	4	60	66	49	46	..	....	1	W	5
18	50	52	50	48	....	..	....	1	S	1	78	75	50	48	..	....	1	S	1
19	60	52	50	48	52-h	..	....	1	S	1	86	78	50	48	..	....	4	SW	3
20	52	56	50	48	....	60	9-16	3	S	2	78	72	52	48	..	....	3	SW	3
21	60	58	54	48	60-h	60	1-16	3	N	2	76	73	54	48	..	....	3	NW	2
22	60	60	54	48	....	..	....	3	NW	2	63	58	54	48	..	....	5	NW	3
23	60	60	54	48	....	60	1-16	3	NW	2	76	70	54	48	..	....	3	S	3
24	60	60	54	48	....	..	....	4	S	4	79	68	54	48	..	....	3	S	2
25	52	58	54	49	....	..	....	1	S	1	88	75	54	49	..	....	3	S	2
26	58	64	54	49	56-l	..	....	2	S	1	73	78	54	49	..	....	2	NW	2
27	44	52	54	49	....	..	....	1	N	2	74	84	54	49	..	....	1	NW	2
28	60	56	54	49	52-	..	....	1	SW	2	88	82	56	50	..	....	2	SW	2
29	60	62	58	52	....	..	....	3	SW	4	88	78	58	52	..	....	5	SW	5
30	60	62	58	52	....	..	....	3	W	3	80	78	58	52	..	....	2	W	3
31	40	49	57	52	40-h	40	1/4	4	NW	4	50	54	57	52	..	....	2	NW	4

REMARKS AT 5 A. M.—Smoky and hazy. 6. Wild plum in blossom. 9. Raining. 11. Raining still. 16. Raining. 20. Fruit trees in full bloom. 23. Raining. Foggy.

REMARKS AT 3 P. M.—1. Rain. 4. Hazy and smoky. 5. Some thunder. Sprinkle of rain. 6. Woods begin to look green. 7. Heavy thunder shower. Hail storm, breaking windows and doing much damage. 10. Raining. 11. Raining. 19. Heavy thunder shower. 21. Some rain and thunder. 22. Dense cold fog. Lowry. 31. Looking for a frost.

NOTE.—h, Heavy dew. l, Light dew.

JUNE, 1848.

DAY OF MONTH.	OBSERVATIONS AT 5 A. M., OR BEFORE SUNRISE.										OBSERVATIONS AT 3 P. M.									
	Temperature of air in shade.	Tem. loose soil 4 inches below surface.	Tem. soil 2 feet below surface	Tem. soil 4 feet below surface	Tem. dew.	Tem. rain.	Depth rain fallen since yesterday, 3 p. m	Degree of cloudiness.	Course of wind.	Force of wind.	Tem. air in shade.	Tem. loose soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. rain.	Depth rain fallen since morning, 5 a. m.	Degree of cloudiness.	Course wind.	Force wind.
1	30	40	56	51	30 fr	..	....	1	NW	3	52	56	56	51	....	....	3	NW	4
2	50	51	56	51	....	..	....	3	S	2	72	83	56	51	....	....	1	S	2
3	62	62	56	52	....	..	....	3	S	3	72	75	56	52	....	....	4	S	1
4	55	55	56	52	54 h	..	....	2	S	1	85	81	56	52	....	....	2	S	4
5	60	59	56	52	....	62	....	4	NW	3	70	69	56	52	65	¼	3	N	1
6	50	55	56	52	....	..	....	4	NW	3	48	54	56	52	....	....	5	NW	3
7	39	45	56	52	....	38	¼	5	NW	3	48	52	56	52	....	....	4	NW	3
8	53	52	56	52	....	49	....	4	N	2	56	62	56	52	....	....	4	N	3
9	48	51	56	52	46 h	..	....	1	N	1	76	70	56	52	....	....	1	NW	2
10	53	60	56	52	52 h	..	....	3	NW	2	78	70	56	52	....	....	1	NW	2
11	52	57	56	52	52	..	....	1	NW	3	69	73	56	52	....	....	2	NW	4
12	40	50	56	52	....	..	....	1	NW	4	50	55	56	52	....	....	1	NW	4
13	39	48	56	52	....	..	....	1	NW	3	54	64	55	52	....	....	1	NW	4
14	44	50	55	52	....	..	....	1	NW	2	58	59	55	52	....	....	3	NW	2
15	55	57	55	52	....	54	¼	2	NW	1	83	70	56	53	....	....	1	NW	2
16	70	66	57	54	....	..	....	1	NW	2	86	79	58	54	....	....	2	NW	5
17	60	68	58	54	59	..	....	1	NW	1	88	78	58	54	....	....	2	NW	2
18	66	64	58	54	....	..	....	2	NW	2	78	68	59	54	....	....	3	NW	4
19	70	68	60	54	....	68	½	3	NW	2	76	66	60	54	76	1-16	3	NW	1
20	64	68	60	54	....	63	1-16	3	W	1	72	70	60	54	....	....	3	NW	2
21	59	60	60	54	....	56	1-16	2	S	3	76	69	60	54	....	....	3	NW	3
22	48	59	60	54	50	..	....	2	NW	2	80	72	60	54	....	....	2	S	3
23	61	60	60	54	....	..	....	4	S	3	79	70	60	54	75	1-16	3	SW	4
24	58	61	60	54	....	..	....	4	NW	5	70	65	60	54	....	....	1	NW	3
25	44	54	60	54	....	..	....	2	NW	2	66	75	60	54	....	....	1	NW	2
26	55	60	60	54	56	..	....	1	NW	1	86	85	60	54	....	....	1	NW	2
27	69	73	60	54	....	..	....	1	S	2	86	84	60	54	....	....	1	S	2
28	64	70	60	54	62	..	....	3	S	2	64	70	60	54	70	¼	6	NW	3
29	62	64	62	56	....	..	....	5	SW	1	82	78	62	56	....	....	2	SW	2
30	64	69	62	56	62	..	....	3	SW	1	83	80	62	56	83	....	2	SW	2

REMARKS AT 5 A. M.—1. Black frost, injured corn slightly. 3, Foggy. 4. Foggy. 5. Raining. 7. Foggy. 11. Light dew. 14. Smoky. 16. Hazy. 17. Heavy dew. 22. Heavy dew. Hazy. 26. Heavy dew. 28. Light dew. 30. Light dew.

REMARKS AT 3 P. M.—13. Smoky. 14. Rain. 15. Beautiful weather. 17. Some smoky. 23. Thunder shower. 28. Heavy rain. Thunder. 30. Some rain. Sprinkle.

JULY, 1848.

DAY OF MONTH.	OBSERVATIONS AT 5 A. M., OR BEFORE SUNRISE.										OBSERVATIONS AT 3 P. M.								
	Temperature of air in shade.	Tem. loose soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. dew.	Tem. rain.	Depth rain fallen since yesterday 3 p. m.	Degree of cloudiness.	Course of wind.	Force of wind.	Tem of air in shade.	Tem. loose soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. rain.	Depth rain fallen since morning 5 a. m.	Degree cloudiness.	Course wind.	Force wind.
1	60	65	62	54	....	....	1/4	3	NW	2	73	70	62	54	....	....	3	NW	3
2	52	60	62	56	50 h	....	....	2	SW	1	65	62	62	56	....	....	4	SW	3
3	62	63	62	56	62 h	....	1 1/4	7	NW	1	68	67	62	56	65	3/4	3	NW	2
4	48	56	62	57	....	....	....	2	NW	4	48	56	62	57	....	....	2	NW	1
5	57	54	62	57	56 h	....	....	.	NW	1	69	66	62	57	....	....	1	NW	2
6	50	59	62	57	48 h	....	....	0	NW	1	80	74	62	57	....	....	2	S	3
7	57	64	62	57	55	....	....	2	SE	1	80	72	62	57	....	....	2	E	3
8	53	62	62	56	....	....	....	3	SE	3	76	70	62	56	....	....	2	SE	2
9	55	62	62	54	54 h	....	....	4	E	3	68	66	62	56	68	1–16	5	E	2
10	61	63	62	54	60 h	....	....	4	SE	2	90	78	61	54	....	....	3	S	2
11	63	63	61	54	62	....	....	3	S	2	90	78	62	55	....	....	3	S	2
12	68	66	62	55	....	....	....	3	S	2	76	78	62	55	....	....	4	SW	2
13	63	68	62	56	.. .	61	1–16	4	S	1	82	79	62	56	....	....	3	NW	3
14	55	68	63	57	55 h	....	....	0	S	1	80	76	63	58	....	....	3	NW	2
15	56	69	62	58	55 h	....	....	3	NW	1	70	80	63	58	....	....	0	NW	2
16	58	66	63	58	N	....	....	3	NW	3	62	68	63	58	....	....	3	NW	4
17	52	59	63	58	....	....	....	1	NW	3	70	74	63	58	....	....	2	NW	1
18	56	48	63	58	55	....	....	3	NW	2	75	66	63	58	....	....	2	NW	1
19	64	48	63	58	....	....	....	..	....	..	..	..	63	58	....	....	..	....	..
20	*	..	63	58	....	....	....	..	....	..	..	..	63	58	....	....	..	....	..
21	..	..	63	58	....	....	....	..	....	..	..	..	63	58	....	....	..	....	..
22	..	..	63	58	....	....	....	..	....	..	..	..	63	58	....	....	..	....	..
23	..	..	63	58	....	....	....	..	....	..	..	..	63	58	....	....	..	....	..
24	60	68	63	58	....	....	....	4	NW	3	74	75	63	58	....	3/4	3	NW	2
25	60	66	63	58	....	....	....	5	NW	2	84	71	63	58	....	....	3	NW	2
26	58	64	63	58	57 h	....	....	4	S	2	80	74	63	58	....	....	3	S	3
27	60	64	63	58	60	....	....	4	SW	3	84	76	63	58	....	1/4	5	NW	4
28	52	60	63	58	52 h	....	....	2	NW	2	74	73	63	58	....	....	2	NW	2
29	60	65	63	58	59 h	....	....	2	NW	2	70	82	63	58	....	....	2	NW	2
30	62	64	63	58	61 h	..	....	3	S	3	84	72	63	58	....	....	3	S	4
31	60	63	63	58	....	60	1/4	6	SE	6	74	70	63	58	70	1/4	4	NW	2

REMARKS AT 5 A. M.—2. Light dew. 3. Continued raining all night. Still at it. 10. Lowry and foggy. 13. Foggy. 14. Foggy. 24. Raining.

REMARKS AT 3 P. M.—2. Commenced raining. Some thunder at evening. 4. Ceased raining p. m. 9. Lowry. 10. Thunder. 11. Some thunder. 12. Raining. 13. Some thunder. 16. Sprinkle rain. 24. Day showery. 31. Raining.

* The blank space above was owing to loosing some of our notes.

1.

2

Lith. of R. H. Pease, Albany.

1. SCHOOLCRAFT INDIAN [illegible].
2. [illegible].

SEPTEMBER, 1848.

DAY OF MONTH.	OBSERVATIONS AT 5 A. M. OR BEFORE SUNRISE.									OBSERVATIONS AT 3 P. M.								
	Temperature of air in shade.	Tem. loose naked soil 2 inches below surface.	Tem of soil 9 feet below surface.	Tem of soil 4 feet below surface.	Tem. dew.	Tem. rain.	Depth rain fallen since yesterday, 3 P. M.	Degree of cloudiness.	Course of wind.	Force of wind.	Tem. air in shade.	Tem. loose naked soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. rain.	Depth rain fallen since morning, 5 A. M.	Degree of cloudiness.	Course wind.	Force wind.
1	58	62	63	60	....			5	W	3	63	66	63	60	....	....	5	NW	2
2	57	60	63	60	....	56	1	6	NW	3	67	64	62	59	....	....	2	NW	4
3	58	61	62	59	....	....	....	6	N	1	72	64	62	59	....	....	2	NW	1
4	62	60	62	59	61 h	....	....	3	N	1	82	66	62	59	....	....	0	NW	1
5	54	61	62	59	52 h	....	....	1	W	1	66	64	62	59	....	1-16	2	NW	3
6	54	62	62	59	53 h	....	....	3	NW	2	63	65	62	59	....	....	0	NW	4
7	39	54	62	59	38 h	....	....	0	N	1	65	64	62	59	....	....	0	N	2
8	42	55	62	59	41 h	....	....	0	N	1	72	62	62	59	....	....	3	NW	2
9	57	58	62	59	57	....	....	5	NW	2	61	60	62	59	....	....	6	NW	3
10	32	52	62	59	30	....	....	0	NW	2	70	65	62	59	....	....	0	NW	1
11	55	57	62	59	....	....	....	3	S	2	62	64	62	59	....	....	6	W	3
12	49	58	60	59	....	....	1¼	6	NW	2	58	58	60	59	....	....	0	NW	1
13	31	50	60	59	....	....	....	0	N	1	58	56	60	59	....	....	0	W	2
14	47	49	60	59	46	....	....	6	SE	5	48	52	60	58	....	....	0	S	1
15	58	56	58	58	56	....	....	4	S	2	48	50	58	58	....	1¼	6	SE	5
16	40	48	58	58	42	....	....	0	NW	1	48	50	58	58	....	....	3	NW	2
17	52	50	58	58	....	....	....	2	NW	2	55	52	58	58	....	....	2	NW	1
18	44	52	56	58	42	....	....	4	W	2	58	50	56	58	....	1-16	3	NW	2
19	44	50	56	58	42 h	....	....	0	NW	1	70	54	56	58	....	....	3	S	5
20	59	56	56	58	....	59	¼	3	S	4	56	54	56	58	....	....	5	NW	4
21	44	50	56	58	43 h	....	....	5	NW	2	52	53	56	58	....	....	2	NW	2
22	42	46	56	58	41	....	....	4	NW	2	38	46	56	58	....	....	5	NW	3
23	34	44	56	58	....	....	....	4	NW	2	49	45	55	56	....	....	3	NW	5
24	42	40	54	56	....	....	....	3	W	2	52	52	54	56	....	....	3	SW	1
25	56	54	54	56	....	55	¼	5	NW	2	59	54	54	55	....	....	5	N	4
26	38	45	54	54	....	....	....	5	N	4	44	53	54	54	....	....	0	NW	1
27	24	40	54	54	....	....	....	0	NW	1	56	56	54	54	....	....	2	NW	2
28	42	44	54	54	....	42	1-16	5	NW	4	46	53	54	54	....	....	3	NW	2
29	44	46	54	54	....	....	....	4	S	4	48	50	53	54	....	....	6	S	3
30	50	50	54	54	....	50	7-16	6	S	1	46	50	53	54	....	....	6	S	1

REMARKS AT 5 A. M.—5. Smoky and foggy. 10. Frost. 13. Heavy frost. 18. Lowry. 21. Sprinkle of rain. 23. Hills white with snow. 27. Frost. 30. Raining and foggy.

REMARKS AT 3 P. M.—11. Thunder shower. 15. Raining. 22. Snow. 24. Sprinkle of rain. 29. Raining. 30. Raining.

OCTOBER, 1848.

DAY OF MONTH.	OBSERVATIONS AT 6 A. M., OR BEFORE SUNRISE.									OBSERVATIONS AT 3 P. M.							
	Temperature of air in shade.	Tem. loose naked soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. dew.	Tem. rain.	Depth rain fallen since yesterday, 3 p. m.	Degree of cloudiness.	Course wind.	Force wind.	Tem. air in shade.	Tem. loose soil 4 inches below surface.	Tem. soil 2 feet below surface.	Tem. soil 4 feet below surface.	Tem. rain.	Depth rain fallen since morning, 5 a. m.	Degree of cloudiness.	Course wind.	Force wind.
1	54	....	53	54	....	54	7–16	7	SE	2	56	....	53	54	....	....	0	S	1
2	56	....	53	54	....	....	....	6	S	1	60	....	53	54	....	....	3	S	2
3	54	....	53	54	....	53	¼	5	SE	2	58	....	53	54	....	....	4	S	2
4	50	....	53	54	....	52	1–16	6	S	0	56	....	53	54	....	....	4	S	0
5	48	....	53	54	....	....	....	5	NW	2	52	....	53	54	....	....	1	NW	2
6	50	....	53	54	....	....	....	.	NW	2	54	....	53	54	....	....	.	NW	2
7	36	....	53	54	....	....	....	0	S	1	64	....	54	54	....	....	2	S	3
8	34	....	53	54	....	....	....	4	S	6	..	....	..	..	....	....	..	N	.
9	22	....	53	54	....	....	....	0	N	1	60	....	54	54	....	....	0	N	1
10	38	....	54	54	....	....	....	2	N	2	50	....	54	54	....	....	0	N	2
11	24	....	54	54	....	....	....	0	N	2	50	....	54	54	....	....	0	N	1
12	30	....	54	54	....	....	....	0	N	3	54	....	54	54	....	....	0	N	2
13	32	....	54	54	....	....	....	1	S	2	56	....	54	54	....	....	2	S	2
14	36	....	54	54	....	....	....	2	S	2	44	....	54	54	....	....	2	S	1
15	40	....	53	54	....	....	....	0	S	2	58	....	53	54	....	....	2	S	3
16	42	....	53	54	....	....	....	4	S	3	52	....	53	54	....	....	5	S	4
17	38	....	53	54	....	....	....	5	NW	4	36	....	52	53	....	....	2	NW	4
18	36	....	52	53	....	....	¼	5	NW	2	40	....	52	53	....	....	6	NW	3
19	34	....	52	53	....	....	¼	5	NW	3	36	....	52	53	....	....	4	NW	4
20	34	....	52	53	....	....	¼	4	NW	3	48	....	52	53	....	....	4	NW	3
21	38	....	52	53	....	....	....	4	NW	3	46	....	52	53	....	....	3	NW	2
22	34	....	52	52	....	....	....	0	NW	2	30	....	55	52	....	....	3	NW	2
23	30	....	52	52	....	....	....	0	NW	1	45	....	52	52	....	....	1	NW	2
24	41	....	52	52	....	....	....	6	S	2	44	....	52	52	....	¼	7	NW	3
25	38	....	52	52	....	....	....	5	NW	2	46	....	52	52	....	....	2	NW	2
26	34	....	52	52	....	....	....	3	S	2	44	....	52	52	....	....	3	S	2
27	30	....	52	52	....	....	....	2	N	1	50	....	52	52	....	....	3	S	5
28	30	....	52	52	....	....	....	0	SW	2	58	....	51	52	....	....	3	S	5
29	52	....	51	52	....	....	....	4	SW	2	56	....	51	52	....	....	7	S	1
30	51	....	51	52	....	....	1	6	S	1	58	....	51	52	....	....	4	S	2
31	53	....	51	52	....	....	¼	6	SW	5	52	....	51	51	....	....	3	W	4

REMARKS AT 6 A. M.—1. Foggy. 2. Raining. Lowry. 7. Frost. 9. Hard frost. 11. Frost. 12. Frost. 13. Frost. 17. Snow and hail, soon disappears. 18. Raining. 27. Frost. 27. Heavy fog. Smoky atmosphere. 29. Rain. 30. Foggy. 31. Thunder.

REMARKS AT 3 P. M.—1. Lowry. 2. Lowry. 4. Foggy. 19. Some rain. 24. Raining. 26. Sprinkle of rain. 28. Smoky. 29. Some rain. 30. Appearance of Rain.

TABLE

SHOWING THE RANGES OF TEMPERATURE OF THE AIR AND SOIL AT CAZENOVIA, MADISON COUNTY, NEW-YORK, FOR DECEMBER, 1848.

DECEMBER, 1848.														
DAY OF MONTH.	Temperature air.			Tem. 2 feet below surface.			Tem. 4 feet below surface.			Direct'n Wind.		Weather.		Rain and snow Gage.
	a. m.	p. m.	eve.	a. m.	p.m.	eve.	a.m	p.m.	eve.	a.m	p.m	a.m.	p.m.	
9	32	33	33	41	40	40	40	40	40	NW	SE	Cl'dy.	Cl'dy	.....
10	38	51	50	41	39	40	40	41	40	S	S	Rain.	Fair.	1.02
11	30	28	27	39	39	39	41	41	41	W	NW	C.	C.	.....
12	25	27	24	39	39	39	41	41	41	SW	SW	C.	C.	.....
13	23	32	31	38	38	38	41	41	41	SE	SE	C.	C.	.....
14	34	39	38	38	37	37	41	41	41	S	SE	F.	C.	.....
15	39	33	31	37	37	37	41	41	41	SW	W	R.	C.	.08
16	32	38	40	37	37	37	40	40	40	S	SE	C.	C & R	.21
17	33	39	37	37	37	37	40	40	40	S	SW	F.	F.	.....
18	33	44	44	37	37	37	40	40	40	SW	SE	F.	F.	.....
19	42	54	38	37	38	38	40	40	40	SW	SW	C.	C.	.....
20	27	31	28	38	38	38	40	40	40	SW	SW	C.	C.	.....
21	16	17	13	38	38	38	40	40	40	SW	NW	F.	F.	.....
22	8	18	20	38	38	38	40	40	40	SE	SE	F.	F.	.....
23	5	16	10	37	37	37	40	40	40	W	SW	C.	C.	.....
24	15	29	30	37	37	37	40	40	40	S	S	Sleet.	R.	.....
25	32	39	32	36	36	36	40	40	40	S	S	R.	R.	.....
26	19	19	16	36	36	36	39	39	39	SW	W	C.	C.	.....
27	14	22	21	36	36	36	39	39	39	S	S	Snow	Snow	.....
28	22	21	14	36	36	36	39	39	39	SW	SW	S.	S.	.....
29	21	25	23	36	36	36	39	39	39	S	S	C.	C.	.....
30	24	29	23	36	35	35	39	39	39	SW	SW	C fog.	C.	.....
31	23	24	23	35	35	35	39	39	39	NW	SW	C.	C.	.....

OBSERVATIONS.—10. Rain commenced at 10 preceding night. 16. Rain at 11 p. m. 17. Aurora. 20. Light sonw. 22. Wind S. and SW. at sunset. 26. High Wind.

[redacted]

EXPLANATION OF THE PLATES.

It is necessary to state, in explanation of the irregularity in the numbering of the plates, that it was expected that this work would embrace several, which I afterwards found it necessary to arrange in another volume. Many of the plates were already printed before this arrangement was concluded. An error also was committed by the engraver in numbering the three plates of the illustration of the diseases or brand of the cereals. The owners of the volume are requested to make the proper correction with the pen.

PLATES I, II, III,

Which illustrate the diseases of the cereals, are referred to in the text as Pl. lv, lvi, lvii.

PLATES 1 *b*, 2 *b*, 3 *b*, 4 *b*, 5 *b*, 6 *b*,

Represent the most common varieties of potatoes which are cultivated in this vicinity. For descriptions, see the text with its references.

PLATE 4.

Marrow Squash, Vegetable Marrow or (as called in other places) *Boston Marrow Squash.* It has long been known and cultivated in the vicinity of Albany as the *Vegetable Marrow*, which is probably the earliest name under which it has been known.

PLATE 5.

Brazil Squash. It is a kind which was but recently introduced. It is a valuable variety, and worthy of cultivation. Color green : short or depressed, with the ends pressed inwards.

PLATE 6.

Custard Squash, is new in this vicinity. It is a fine kind, and ranks with the *Vegetable Marrow* in quality, though I am not ready to admit that it is superior. It is easily distinguished from other kinds by its strong longitudinal ribs, extending its entire length, and by their alternating with short and imperfect ones.

PLATE 7.

Egg-plant. Fruit thick and somewhat pyriform, purple : stem armed with spines.

PLATE 8.

Structure of wood as magnified about five diameters.

Fig. 1. Chestnut, with its bark, showing in the wood the annual layers which are distinguished by large pores arranged in three lines, and by faint whitish perpendicular bands which show the arrangement of the secondary pores. The bark, in this as in all trees, undergoes remarkable changes in the arrangement of the annual layers, becoming in many instances oblique and obscure. The wood is clearly different in structure from the oak (fig. 5).

FIG. 2. WHITE ELM. The oblique and undulatory arrangement of the secondary pores of the wood is a feature characteristic of the elms. Primary pores in a single row. The wood of three years in contrast with which is the last annual layer of bark, which shows the perfect regularity of the medullary rays, which are continuous with those of the wood. Old bark corky and finely granular.

FIG. 3. BASS-WOOD (*Tilia americana*). The structure of the bark is worthy of attention; the medullary rays unite in the form of a pointed brush or pencil.

FIG. 4. PAWPAW (*Asimina triloba*). The circle of primary pores single, and more distinct than in the Bass-wood. The arrangement of the medullary rays of the bark is quite similar to the bass.

FIG. 5. CHINQUAPIN OAK. Two sections cut transversely, and magnified about five times. The striking difference of structure is manifest on comparing the oak with the chestnut (fig. 1). All the small figures of Plate S indicate the size of the sections.

PLATE 9.

FIG. 1. Transverse section of a portion of two adjacent annual layers of the POPLAR (*Populus tremuloides*). Secondary pores belong to three kinds: the large, which are divided by a thin diaphragm; the middle sized are of a pentangular form, and are irregular in their arrangement; the smallest contain dots or subordinate cells.

FIG. 2. Section perpendicular to the medullary rays.

FIG. 3. Section parallel to the medullary rays.

FIG. 4. WHITE ELDER (*Sambucus canadensis*). Transverse section.

FIG. 5. Section perpendicular to the medullary rays.

FIG. 6. Section parallel to the medullary rays.

FIG. 7. WHITE-WOOD (*Liriodendron tulipifera*). Transverse section.

FIGS. 8 & 9. Correspond with the former.

PLATE 10.

FIG. 1. Transverse section of the Walnut or Hickory. An interrupted single circle of large pores marks the commencement of growth of the wood. The interrupted belts indicate the direction of fine lines in the wood. The dark lines represent the medullary rays.

FIGS. 2 & 3. Sections perpendicular and parallel to the medullary rays.

FIG. 4. WHITE OAK (*Quercus alba*). Section transverse to the trunk shows, in the darker parallel lines, the structure of the medullary rays.

FIG. 5. Shows the structure of the same ray, when cut by a line tangent to its line of growth.

FIG. 6. Section parallel to the medullary ray, showing its structure as brought out by this cut.

FIG. 7. BLACK OAK. The three sections correspond to those of the White Oak.

PLATE XI.

CONIFEROUS WOODS. 1. Transverse section of White Cedar.

FIGS. 4, 5, 6. Sections of the Red Cedar.

FIGS. 7, 8, 9. Sections of the Norway Pine.

The coniferous woods or pines exhibit a remarkable similarity of structure, as revealed in these sections. Still there are differences worthy of note, and might be employed in distinguishing species from each other.

PLATE XII.

FIGS. 1, 2, 3. BUTTON-WOOD (*Platanus occidentalis*). Sections corresponding to those already noticed.

FIG. 4. BEECH. Transverse section. The dark belt shows the singular structure of the medullary ray.

FIGS. 5 & 6. Sections of the same wood.

FIG. 7. BUCKTHORN. The oblong spaces which are left nearly white, are the spots thickly implanted with secondary pores. The wood is easily distinguished from all others by its singular structure.

FIG. 8. CHERRY.

FIG. 9. Transverse section of the PLUM.

PLATE 13.

FIG. 1. *Melia azedarach.* Section magnified four diameters, containing both bark and wood.

FIG. 2. Section of the potato, showing its structure in a healthy state. The hexagonal cells contain the starch granules. The spiral vessels are indicated by the three spirals upon the right; these vessels are always found in the vicinity of an eye. In a diseased potato, the cells are broken down more or less, but the starch granules remain unchanged in the midst of the decomposing fluids. These decomposing fluids contain the nitrogenous bodies, as albumen and casein, which are at first acted upon, and which results in their decomposition, as is evident from the exhalation of ammonia. Hence the nutritive powers of the diseased potato are first diminished, while the calorifient power is the last to pass away.

FIG. 3. DOGWOOD (*Cornus florida*). Medullary rays are remarkably continuous in this wood, extending frequently from the centre to the circumference.

FIG. 4. HIGH BLACKBERRY (*Rubus villosus*). Transverse section of the stem.

FIG. 6. RASPBERRY. From comparison of the structure of the two stems, it would seem expedient to separate the High Blackberry from the Raspberry.

FIG. 7. Transverse section of BLACK ASH.

FIG. 8. Transverse section of WHITE BIRCH.

FIG. 9. Transverse section of the BLACK BIRCH (*Betula excelsa*). It appears, from the structure of the stems of the several species of birch, that they are more closely allied than many other species. So close is the resemblance, that it is extremely difficult to distinguish them : the resemblance, in fact, is greater than in two species of the Pine.

PLATE 14.

FIG. 1. Transverse section of the CANADA BALSAM.

FIG. 2. Section parallel to the medullary rays, showing the dotted tissue in a medullary ray.

FIG. 3. Section perpendicular to the medullary rays.

FIG. 4. Transverse section of the TAMARACK.

FIG. 5. Transverse section of HEMLOCK, magnified about five diameters.

FIG. 6. Transverse section of Hemlock, greatly magnified.

FIG. 7. Section of the WHITE ELM parallel to the medullary rays, showing the spiral vessels of the wood.

FIG. 8. Transverse section of the TAXUS.

FIG. 9. Transverse section of the WHITE ELM.

PLATE 26.

Varieties of Maize. Early Tuscarora Corn. For description, see text under the head of Corn or or Maize.

PLATES 27, 28, 29.

Varieties of Wheat. For description, see the text.

PLATE 48.

Prince's Early Pea. This pea, as its name implies, is early, and is valuable, inasmuch as it is equal in goodness to the *Marrowfat*. The pod shows that it bears well.

PLATE 49.

Fig. 1. *Orang Carrot*, showing the structure of its root by a tranverse section.

Fig. 2. *a*, longitudinal section of the Beet; *b*, transverse section. The yellowish white band communicates with the double row of fibres upon the outside.

PLATE 54.

BLACK TANTAIN OAT.

PLATE 57.

Two varieties of Barley. Fig. 3. Barley brand. Fig. 4. Spores of the barley brand, or smut, greatly magnified.

Plates illustrating the mean monthly ranges of temperature, and the semi-monthly mean for the year, have been compiled from registers kept at Albany for the year 1848. The register was kept by Mr. J. SALISBURY. For a part of the year, a register has also been kept by NATHAN SALISBURY, Esq. of Scott, Cortland county. These observations I have tabulated also, and they appear on the plate of the same month with the Albany observations. In 1844, I kept a register of the temperature of the soil and air. The entire series of observations agree in the indications of the range of temperature for the periods at which they were made. Scott is about 1200 feet above Albany; Hoosic-falls, about 450 – 500.

The object in constructing these tables, was to present to the eye the facts which are so obscure to most minds when given merely in figures. Observations at Rensselaerville, Albany county, made by my friend Mr. H. A. GALLUP, and also by Mr. BANNISTER of Cazenovia, agree very nearly with those made at Scott. These places differ only a few feet in height.

The inspection of these plates will convey a clear conception of the changes of temperature in this section of the State. This fact, however, would have appeared in a stronger light had I constructed them from the extremes of observed temperature for the day.

The earth, at the depth of four feet, it will be seen, presents for some months a uniform range, not a little change occurring for many days in succession. The difference between two feet and four feet is quite remarkable, amounting to two or three degrees. It is interesting to observe how the ranges of temperature represented by the lines cut the arches formed by the air line at different periods of the year.

It may be proper to observe, in explanation of these plates, that on the left margin the degrees are placed, and the day of the month upon the upper. If it is wished to know what the mean temperature was for any day of any given month, it is found at the junction of the horizontal and corresponding lines: the line of temperature touches at each intersection.

BRAND IN CEREALS

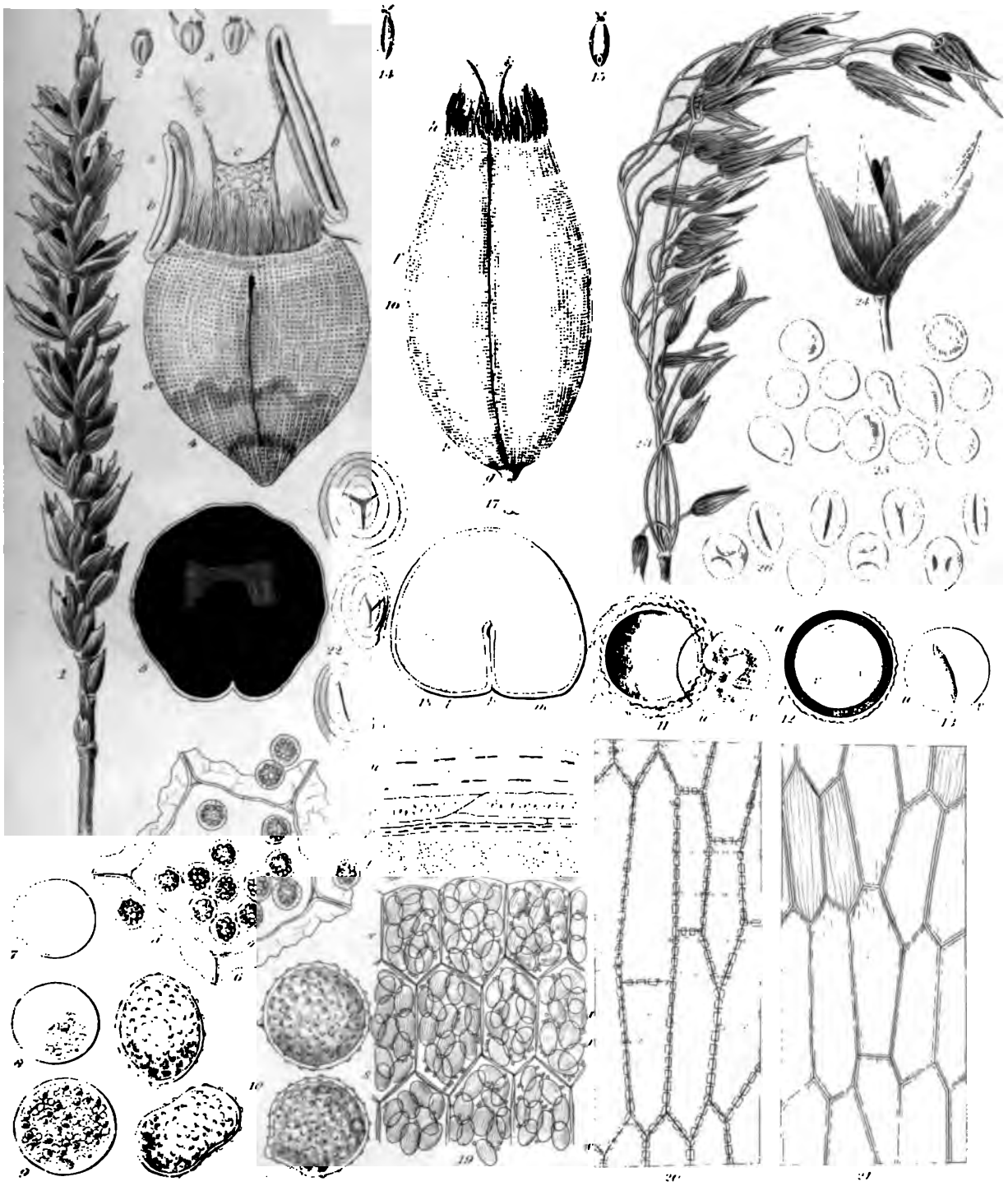


Fig 1–22 Ustilago segetum Dittmar *Fig 23–30 Ustilago Avenae* Corda

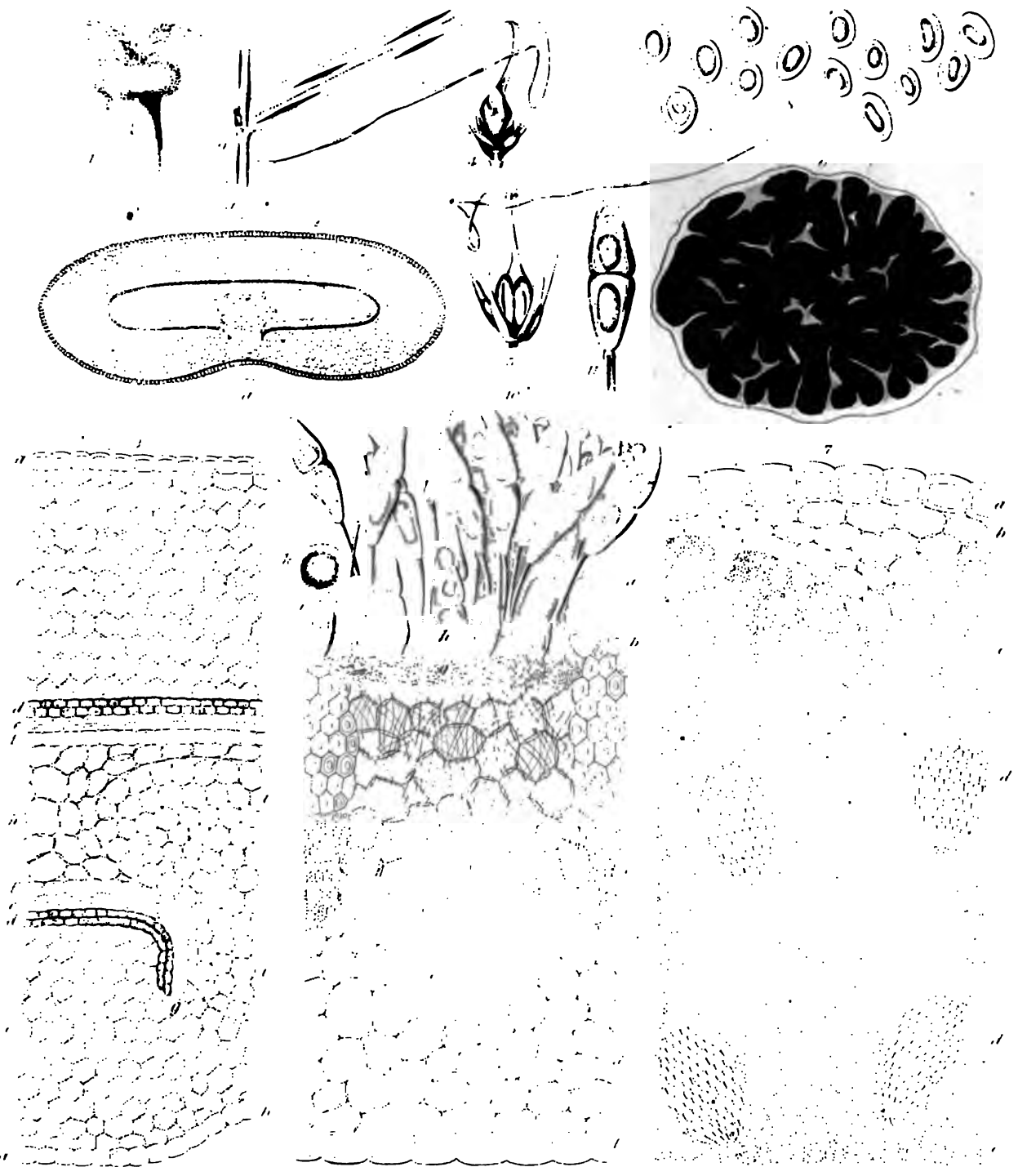


Fig 1 & 2 Ustilago segetum Pers *Fig 3 & 4 Ustilago carbo* Pers

[redacted]

BRAND IN CEREALS

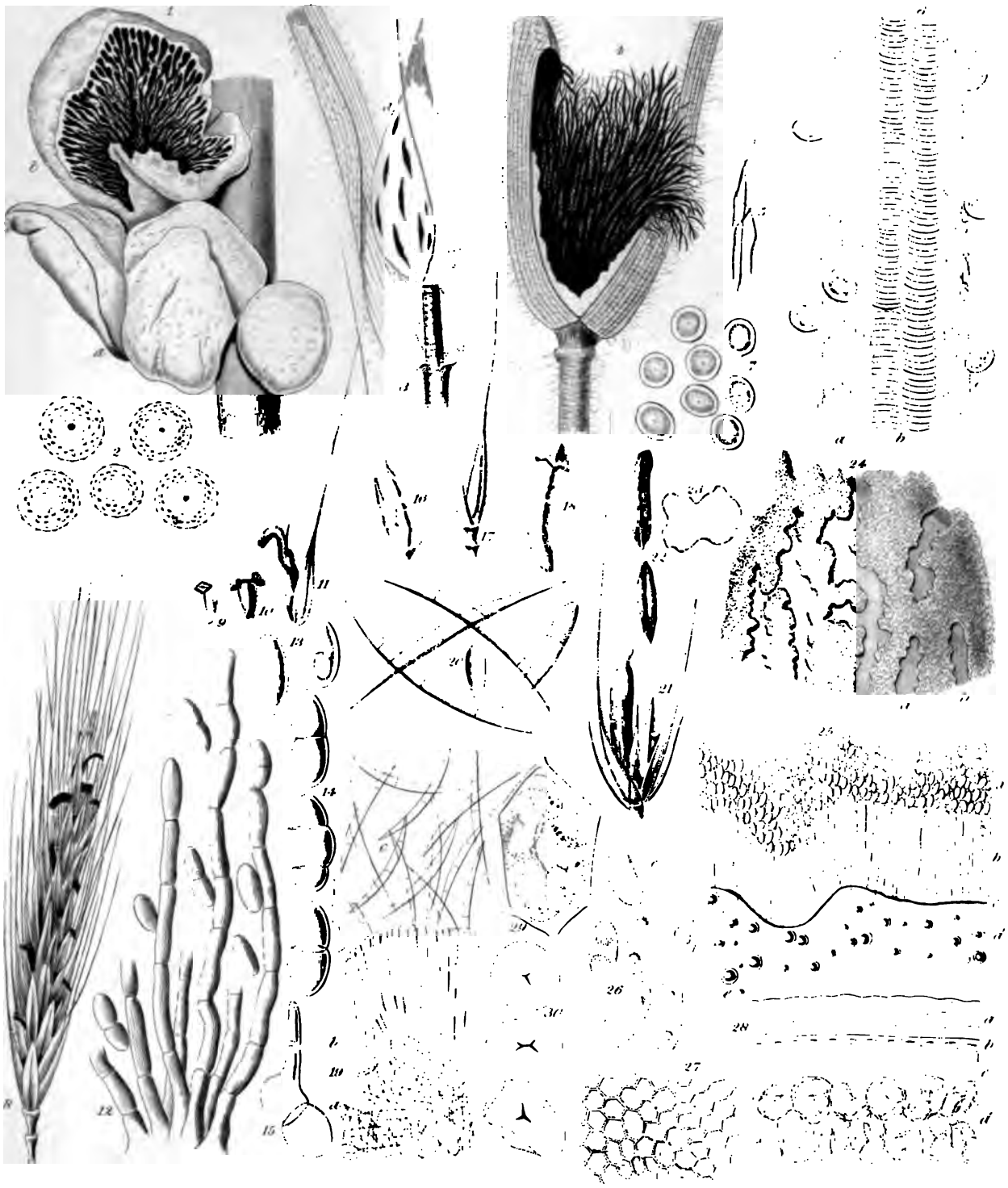


Fig 1 .2. Uredo Maydis Fig 3 7 Uredo destruens Schlecht *Fig 8. 15 Cladosporium herbarum* Link

Fig 15 20 Septosporium graminicum Corda *Fig 21 30 Hymenula Clavus* Corda

Engraved & Printed by

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On Stone by F. J. Swinton

Lith. of R. H. Pease, Albany.

1. YELLOW ROUND PUNK BUG.

2 PEACH BLOW.

1

2

Stone by F. Swainson

1.

2.

In Stone, by F. J. Swinton

Lith of, R. H Pease, Albany.

1. COW'S HORN.
2. EARLY SHAW.

Ch. Sinnet, by H. Swinton.

Lith. of R.H. Pease, Albany.

1. EARLY KIDNEY.
2. EARLY BLUE.
3. ORANGE.

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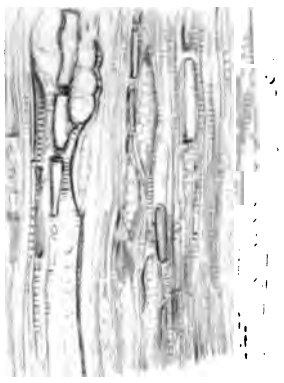

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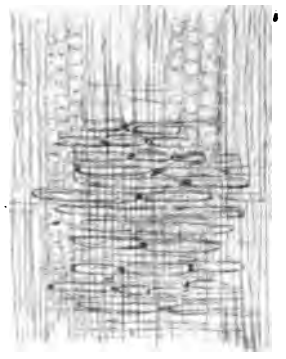

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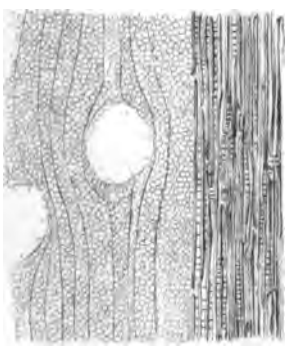

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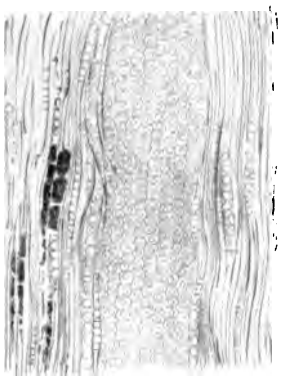

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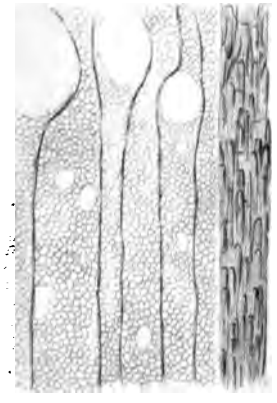

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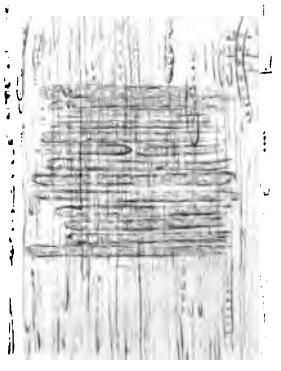

WOOD STRUCTURE.

Drawn by F. Kemmons, Jr.

Engraved & Printed by Gantt & Dubbs

Lith of R.H Pease, Albany.

Seed.

Corrected.

P. D. Grass Lith. Albany.

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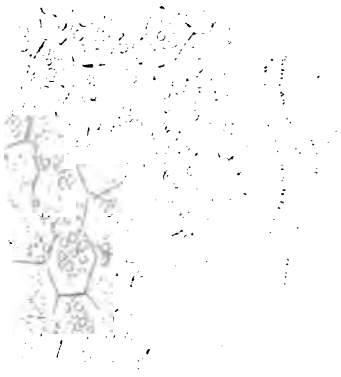

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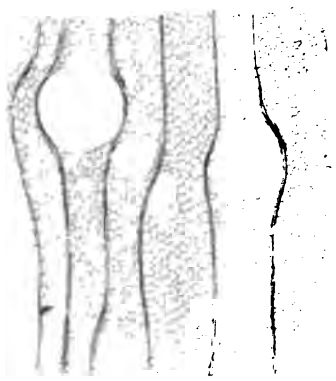

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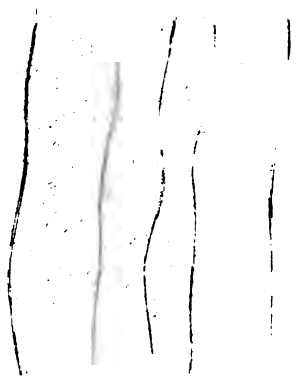

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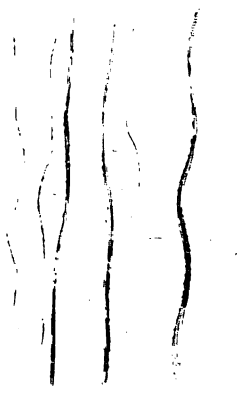


STRUCTURE OF WOOD.

Drawn by W.Emmons Jr.

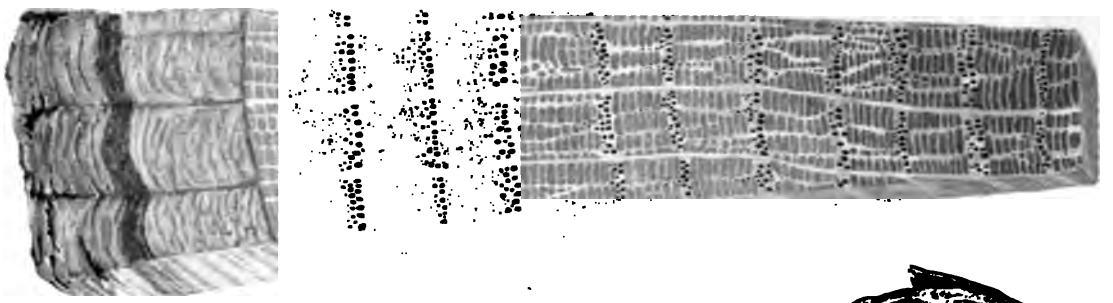
Engraved by D.Dennis, Harrisburgh.

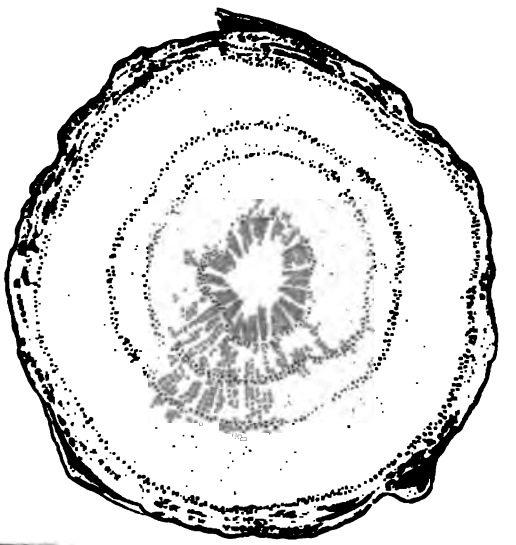
Pl. 6.

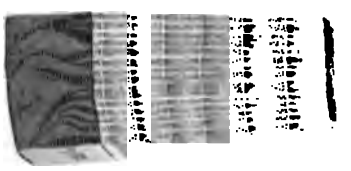
J. H. Peace Lith. Albany.

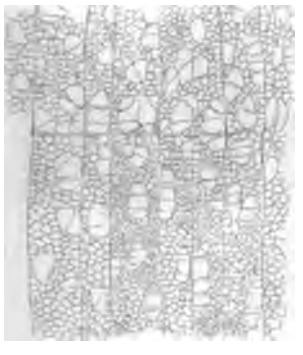
CUCURBITA MOSCHATA.

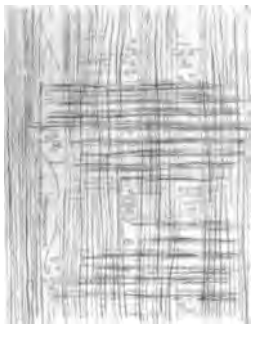
CORN.

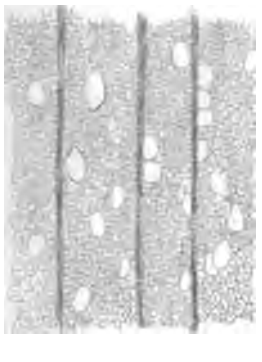












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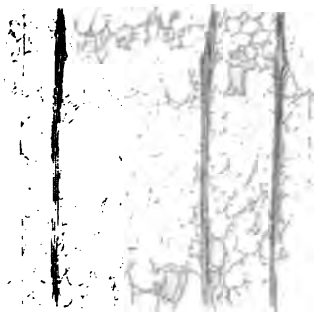

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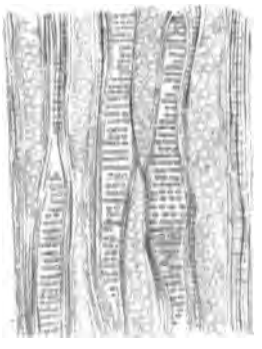

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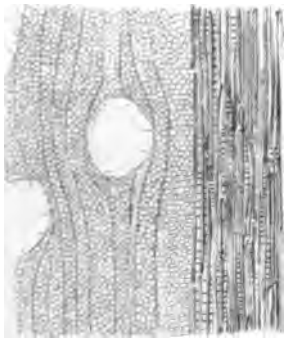
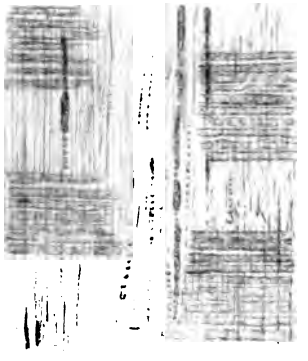
WOOD STRUCTURE.

Drawn by E Emmons, Jr

Engraved & Printed by Sarony & Dobbie





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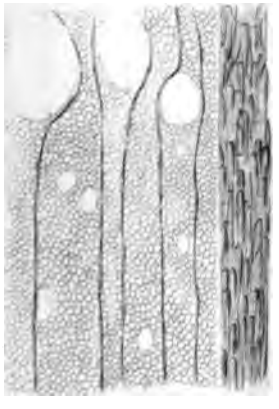

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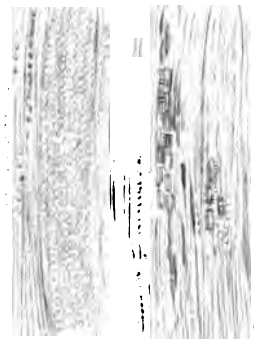

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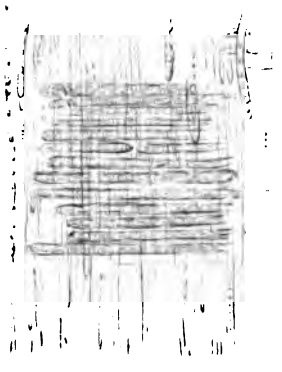
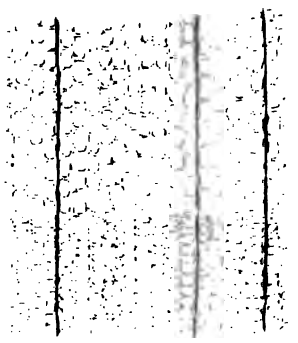


WOOD STRUCTURE.

Drawn by K.Kimmons, Jr

Engraved & Printed by Gantt & Crutcher

WOOD STRUCTURE



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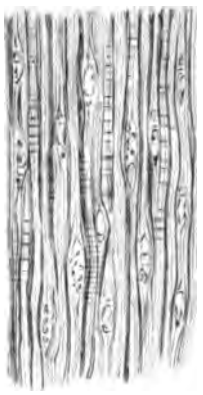

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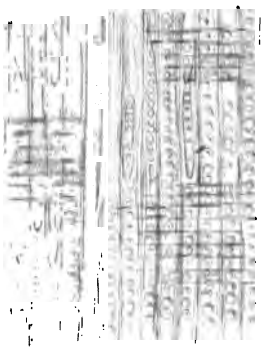

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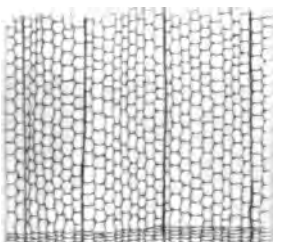

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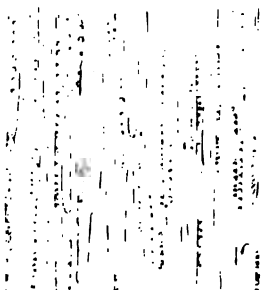

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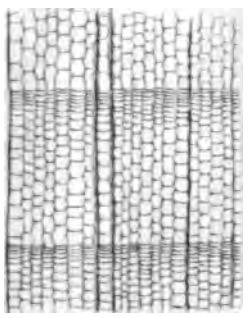

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PL 51

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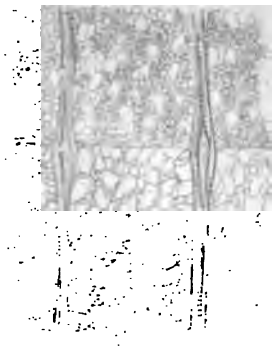

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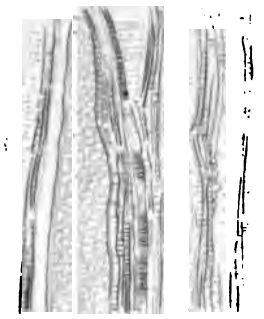

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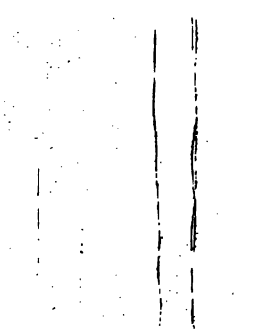

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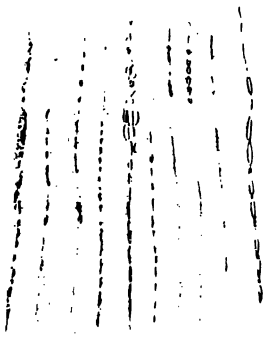

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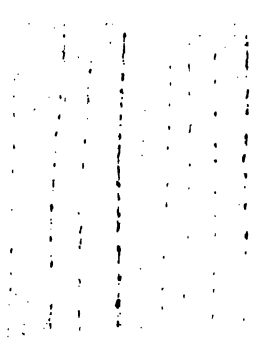
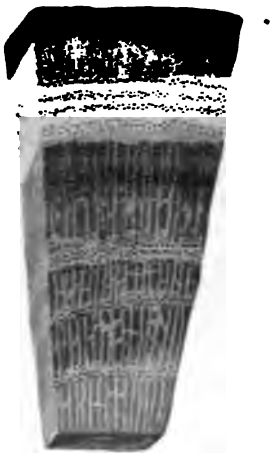
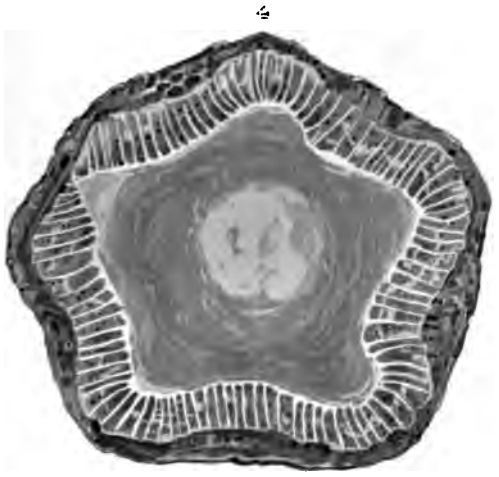
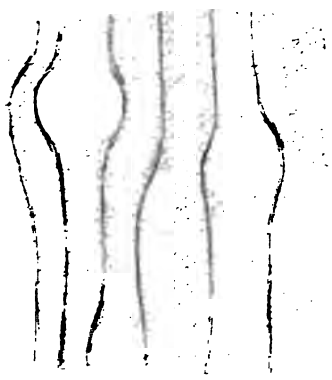
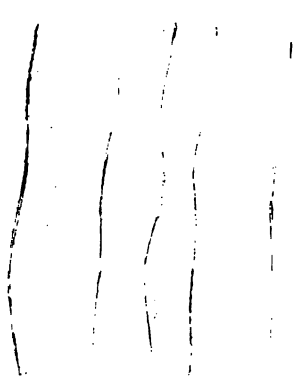


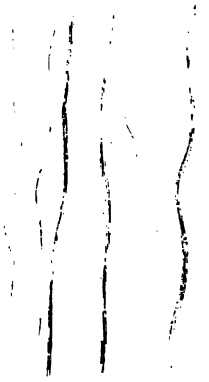
STRUCTURE OF WOOD.











STRUCTURE OF WOOD.

PLATE XXVII.

W ENDICOTT E EMMONS Jr. DEL. 99 BEEKMAN St N YORK

1. Sowles red chaff.
2. Virginia may.
3. Tea spring wheat.
4 Velvet chaff bald.
5. Wheatland yellow.
6. Virginia blue stem.
7. Bearded baltic.
8. Humes white.
9. Skinners club.
10 Old bearded tuscany.
11. Pale red chaff.
12. Crat or velvet bearded.
13 Baltic downy.
14. Old black beard.
13. Poland white beard.
16. Talavera Egg
17. New velvet chaff bearded

. Rock Wheat.
. Yorkshire.
. Wheatland Red.
5. Black Velvet Chaff.
6. Bald Baltic.
7. White Provence.
9. Soules White Chaff.
10. Old White Flint.
11. Scotch Club.
13. Early Velvet Beard.
14. Italian Spring Wheat.
15 Bald C: Red· Chaff.

G & W. ENDICOTT LITH N. YORK.

E. Emmons jr. delt

Lith. of R. H. Pease, Albany

LANDRETHS EARLY PEA.

E Emmons jr delt

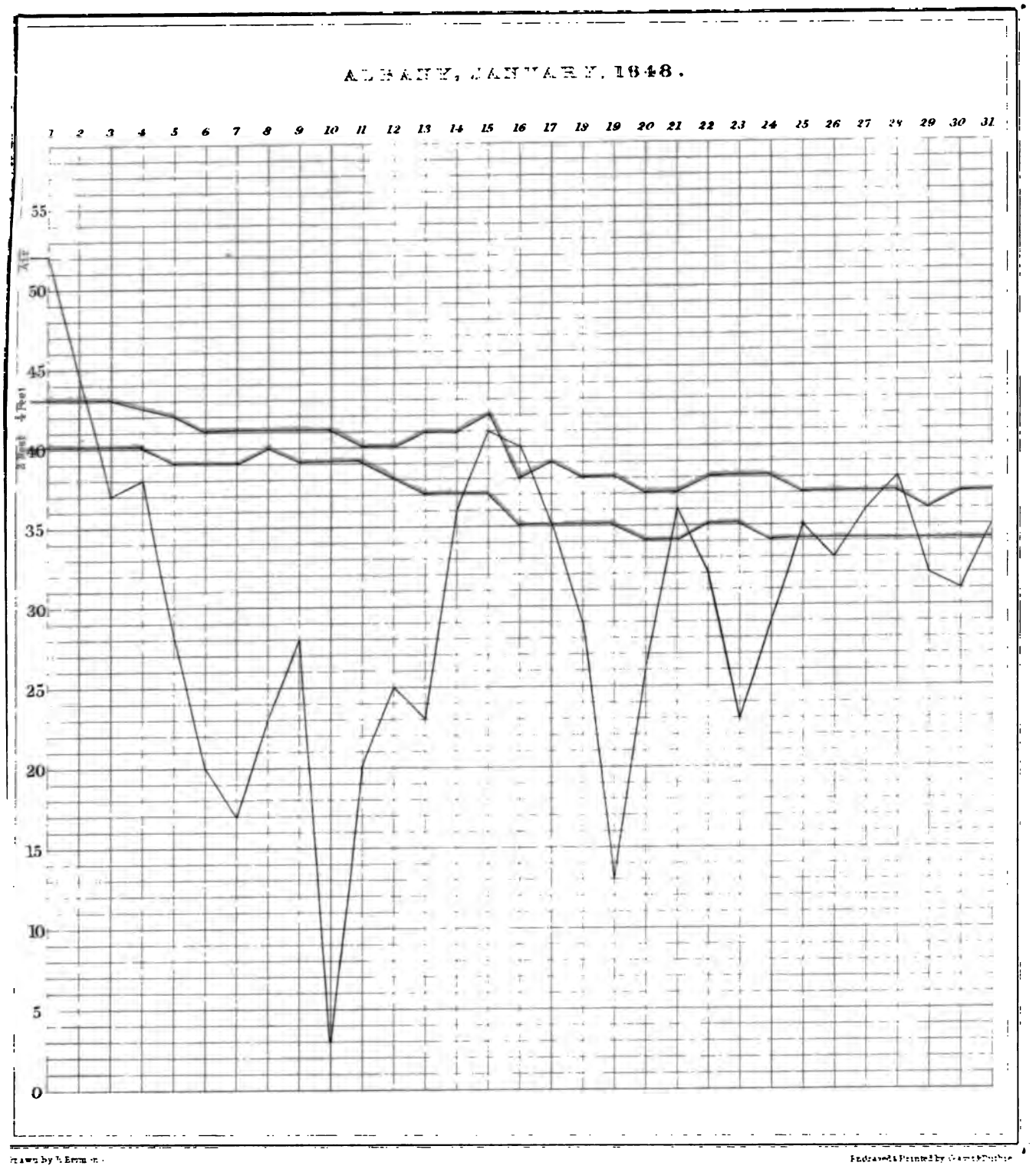
Lith of H H Pease, Albany

LANDRETHS EARLY PEA.

OATS.

OATS.

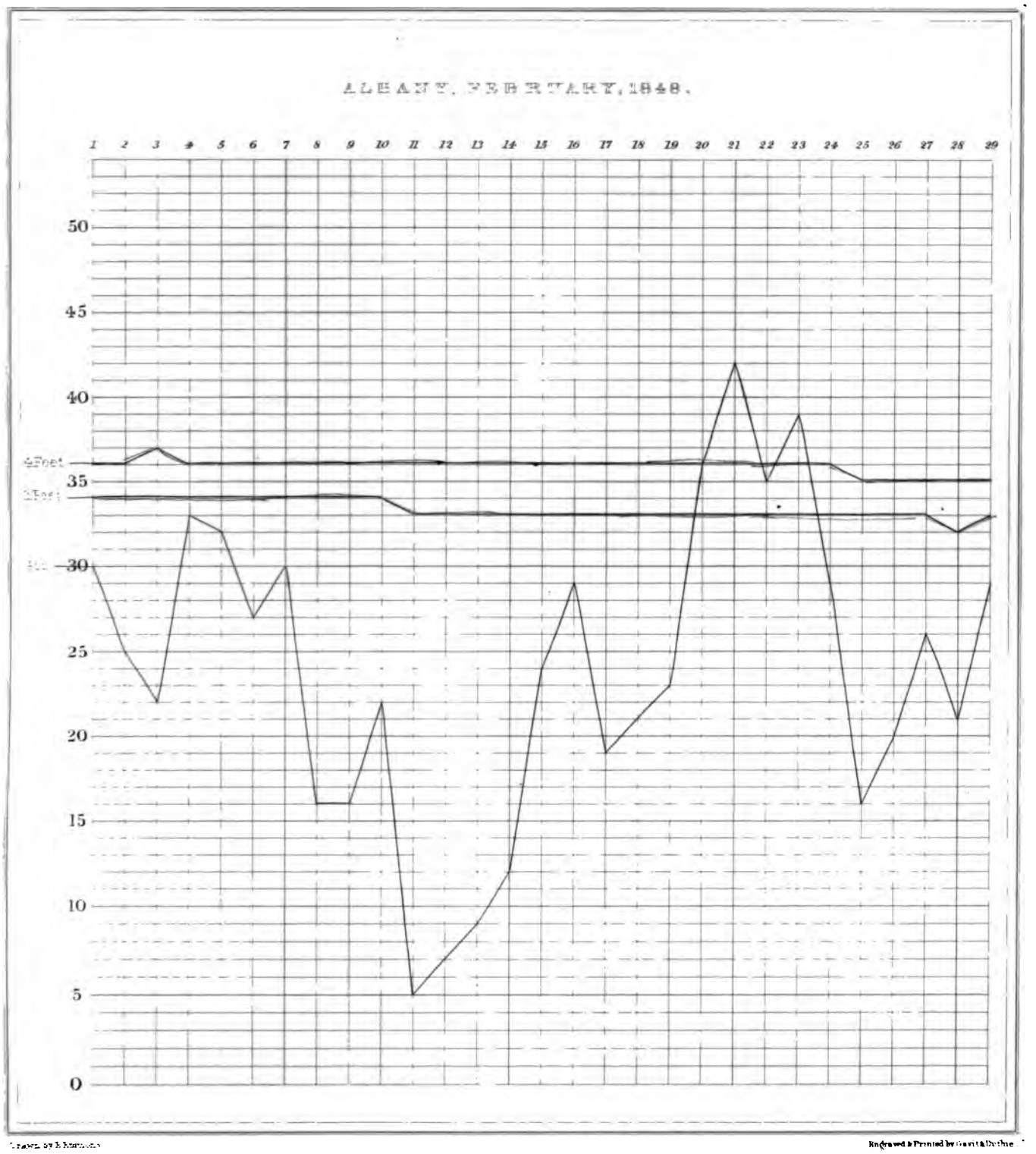
OBSERVATIONS ON TEMPERATURE.



Drawn by T. Brunner

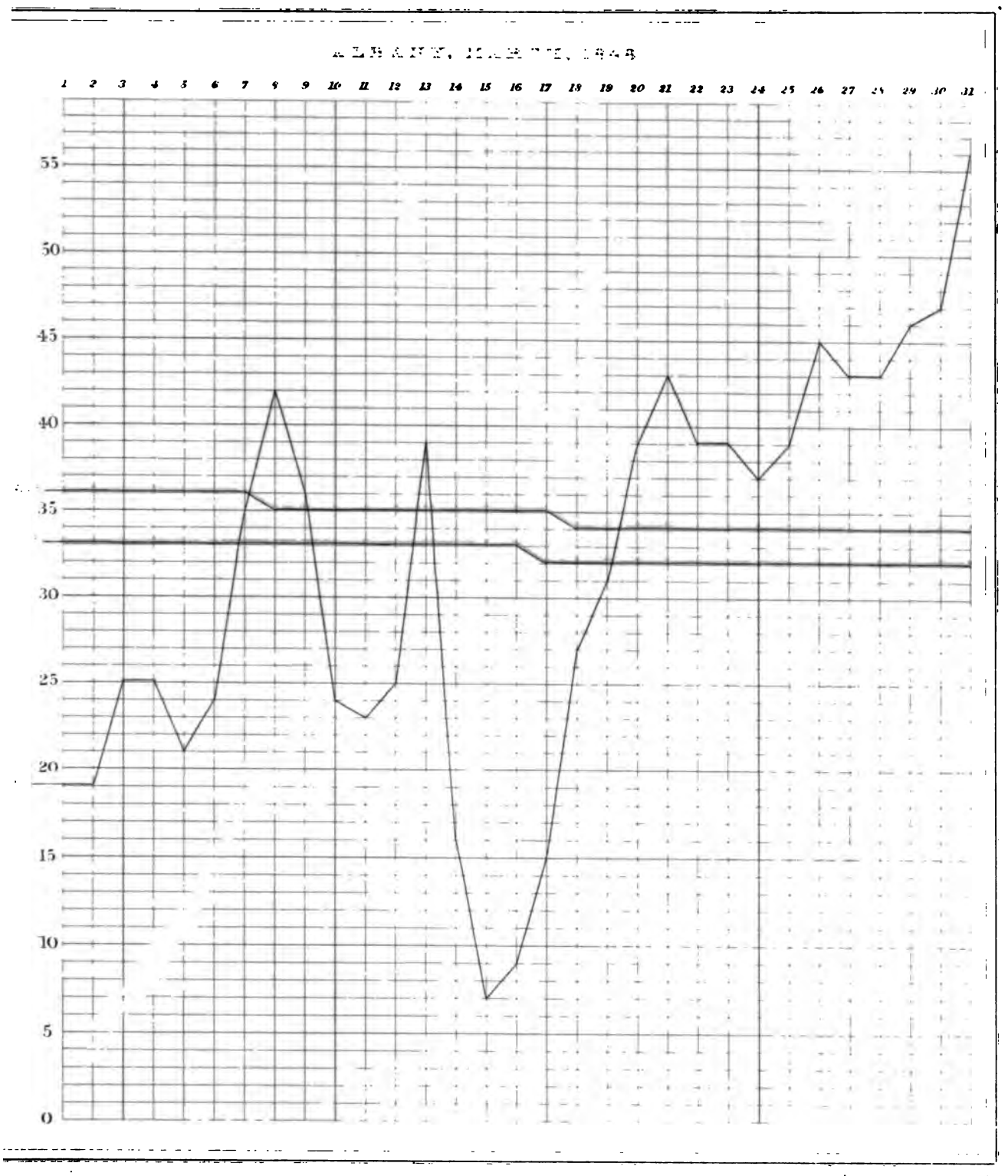
Engraved & Printed by Sherman & Smith

OBSERVATIONS ON TEMPERATURE.



Engraved & Printed by Gavitt & Brother

OBSERVATIONS ON TEMPERATURE.



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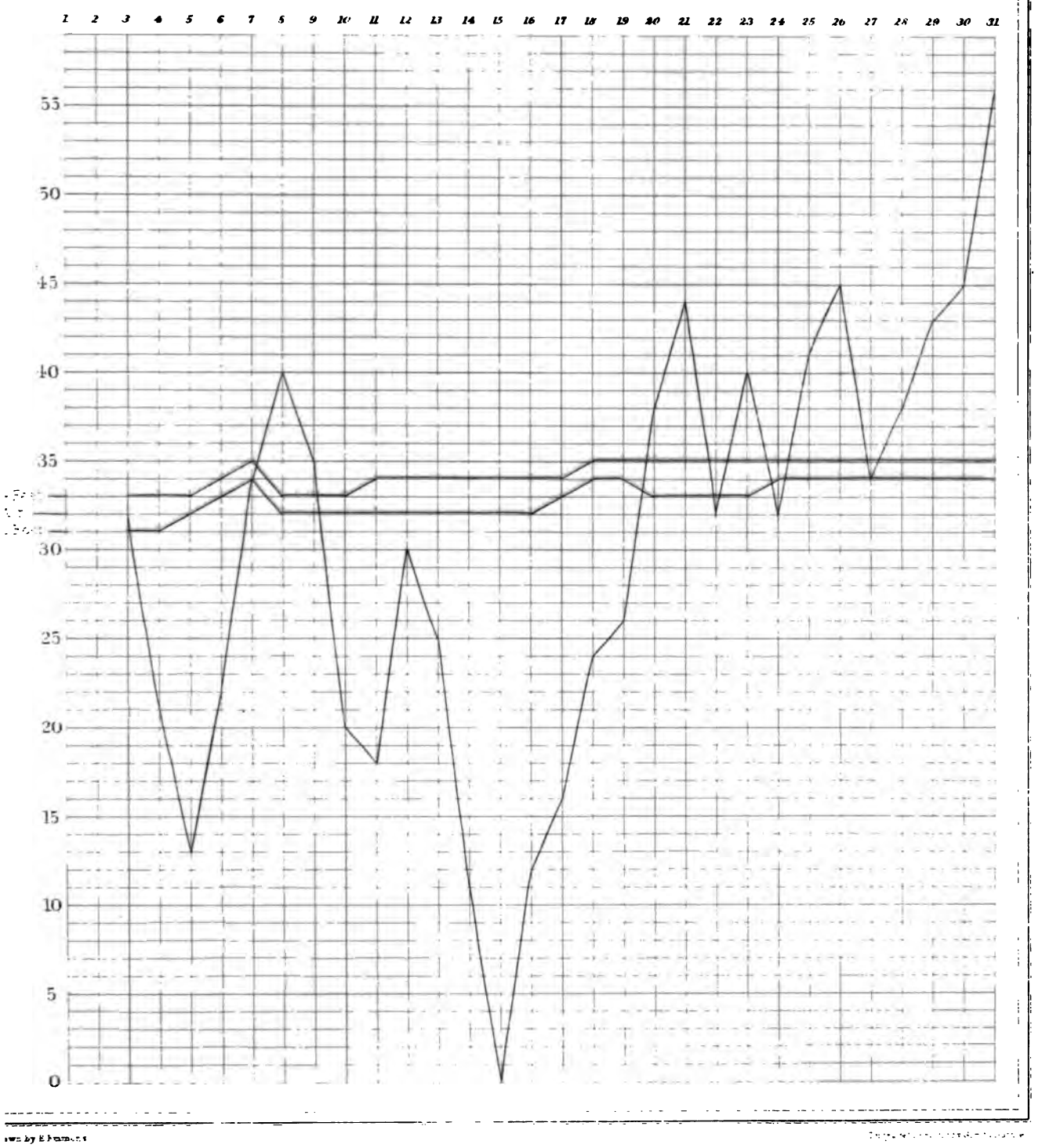

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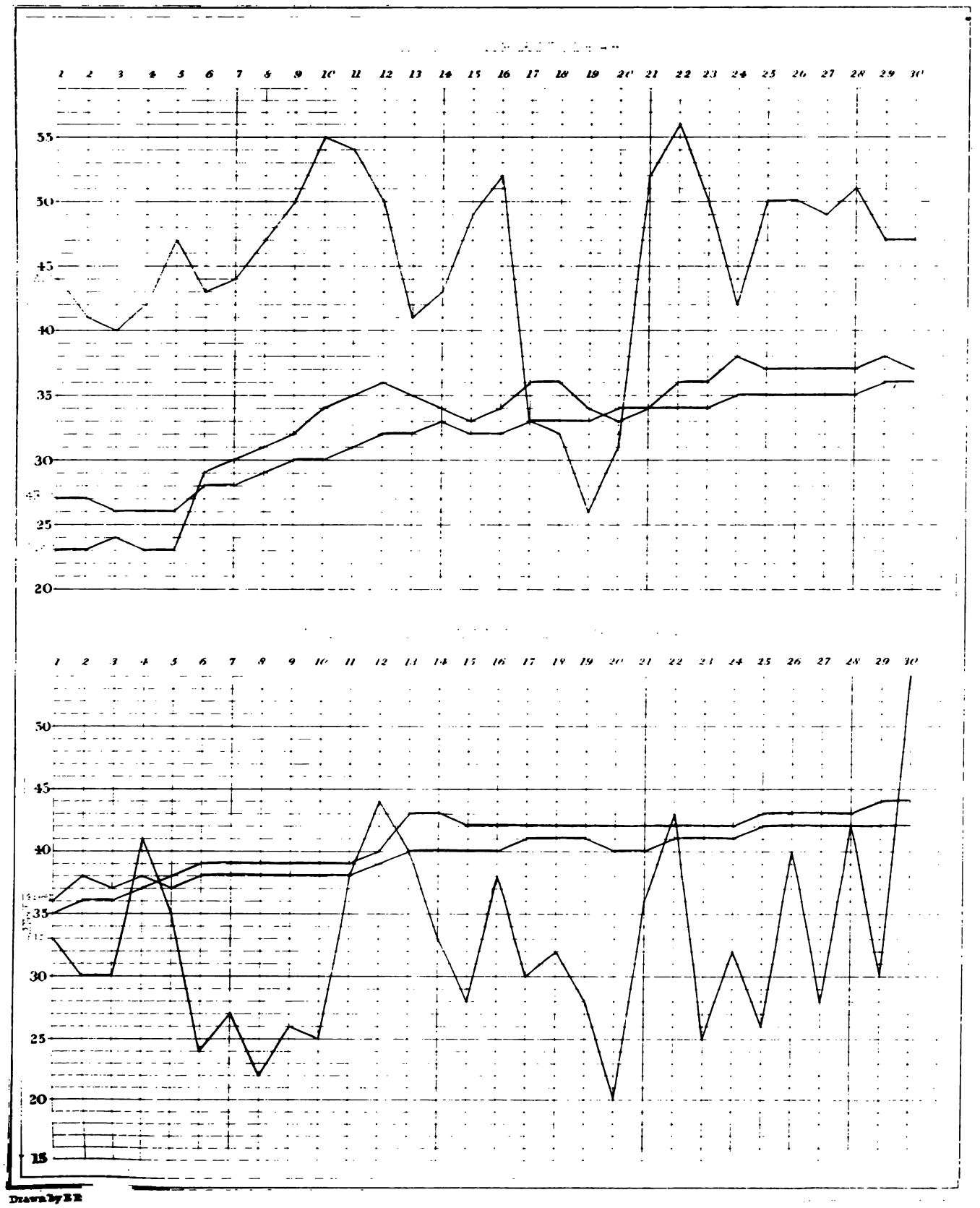

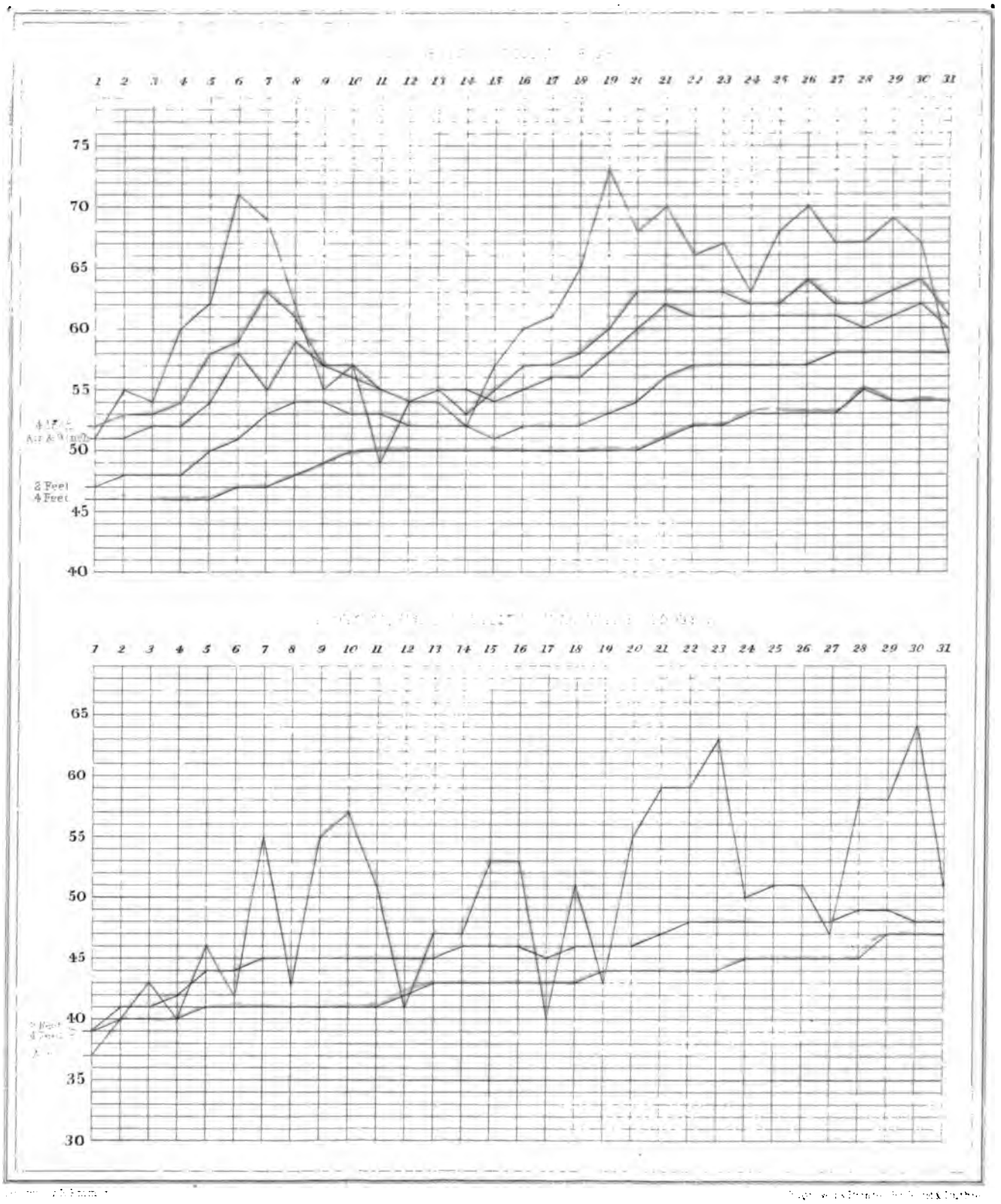
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75
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2 Feet
4 Feet
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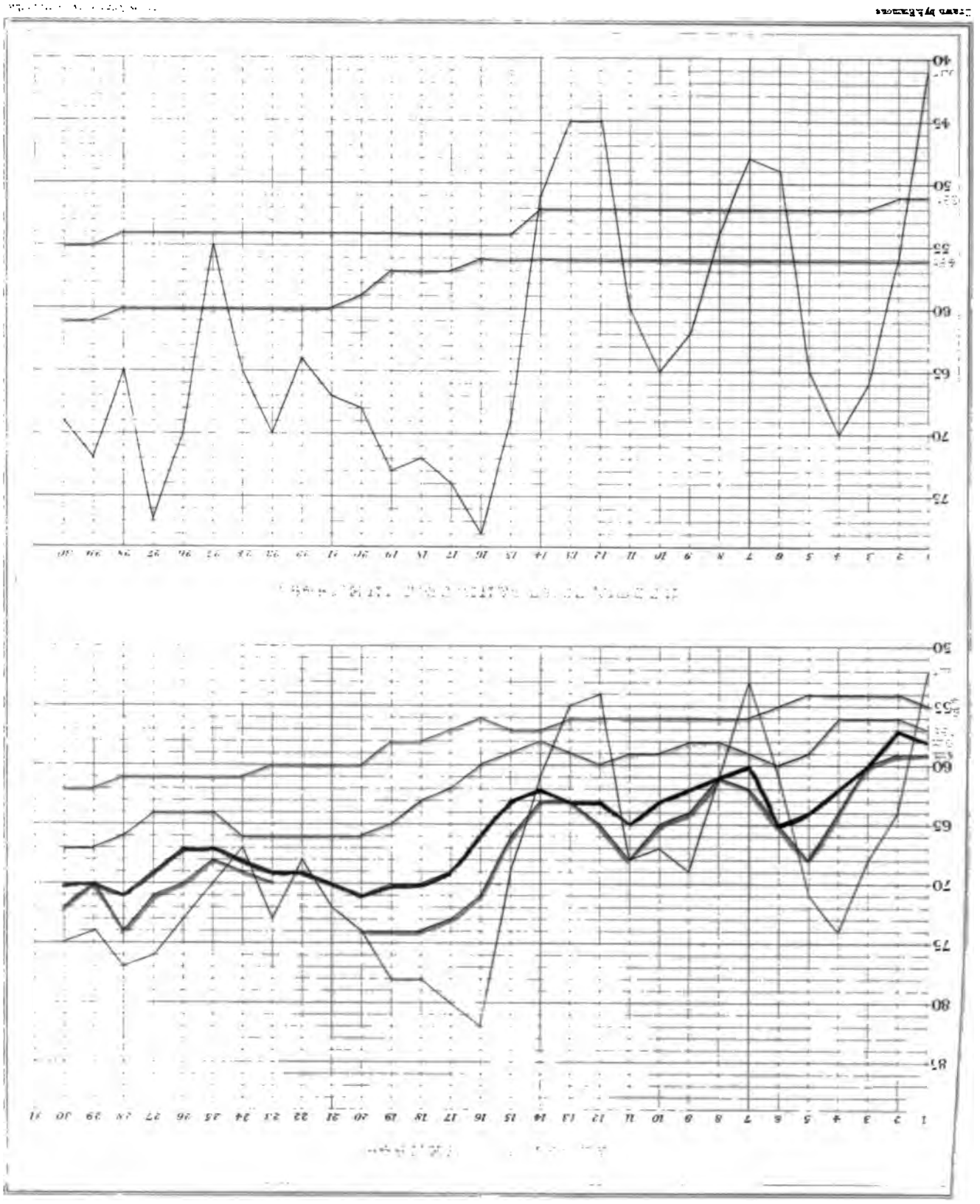

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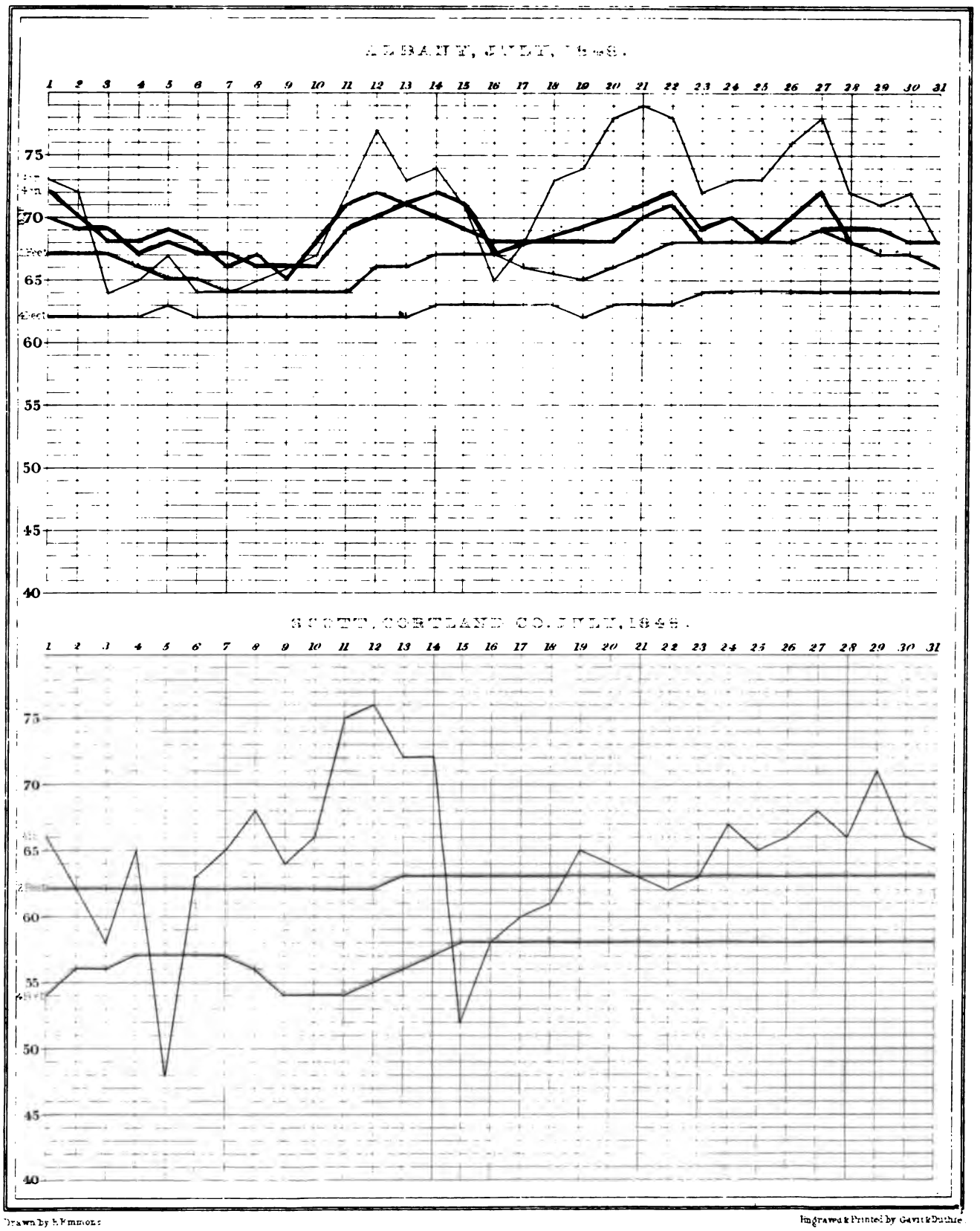
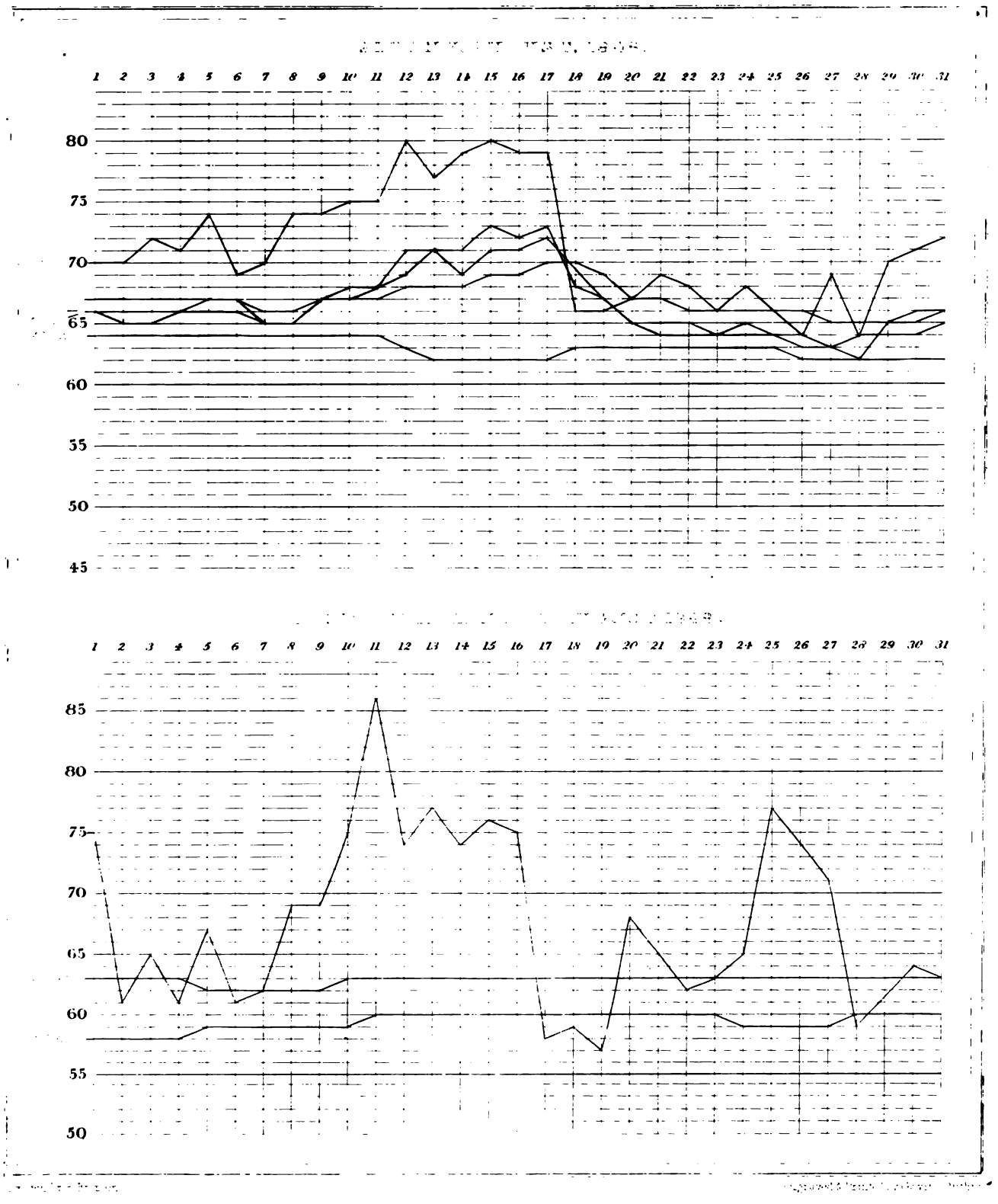


Drawn by B. Emmons

Engraved & Printed by Gavitt & Duthie

OBSERVATIONS ON TEMPERATURE.



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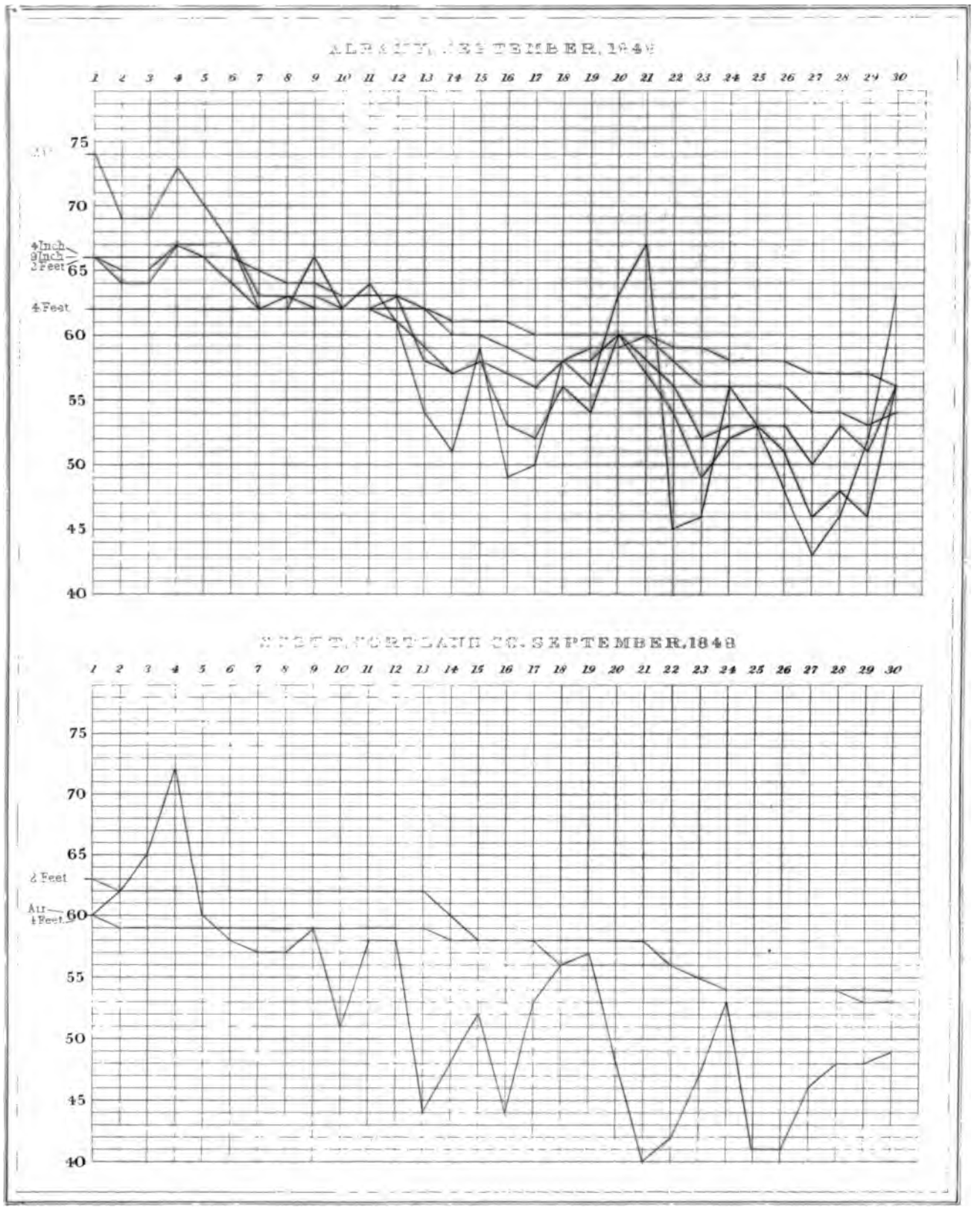

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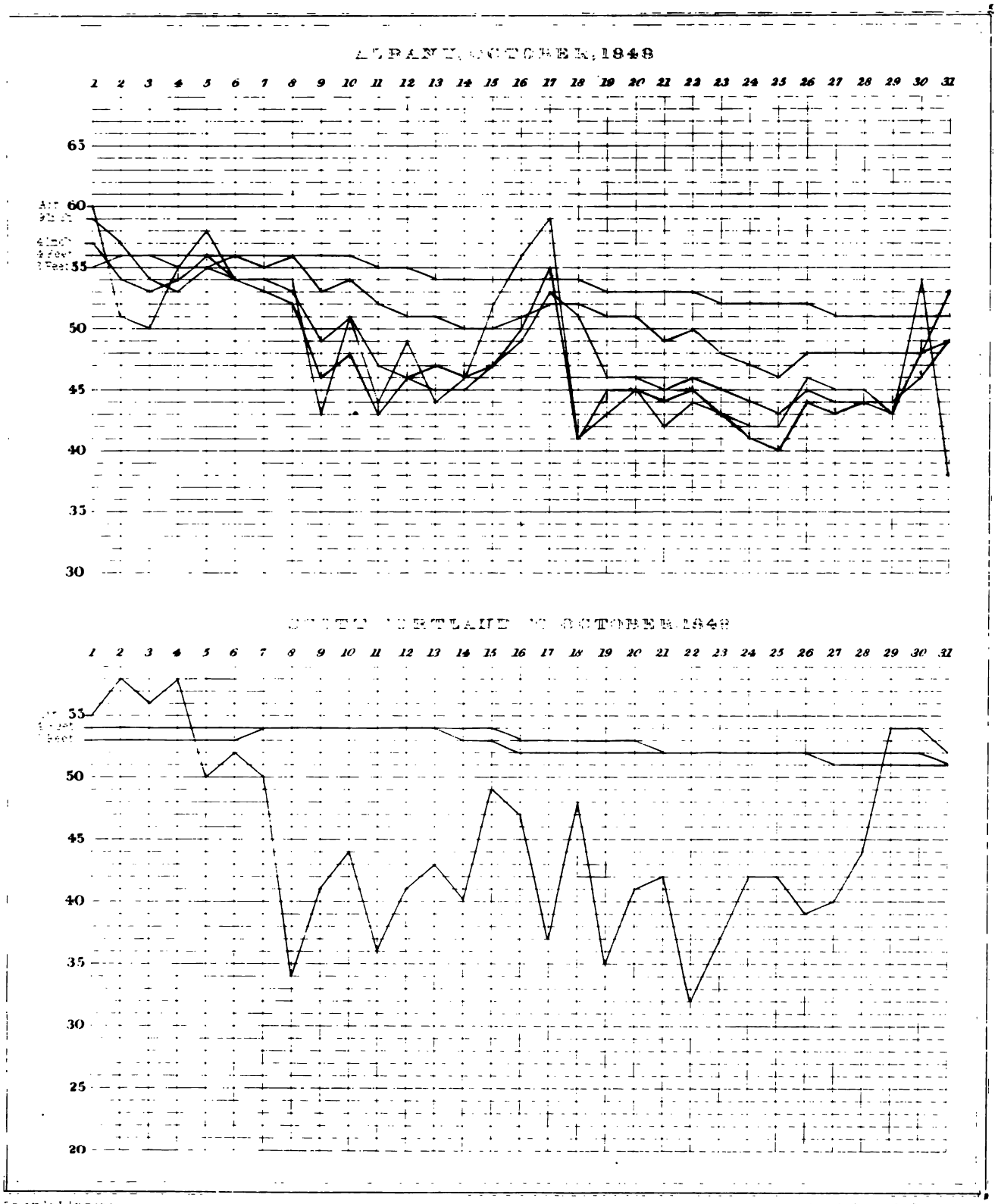

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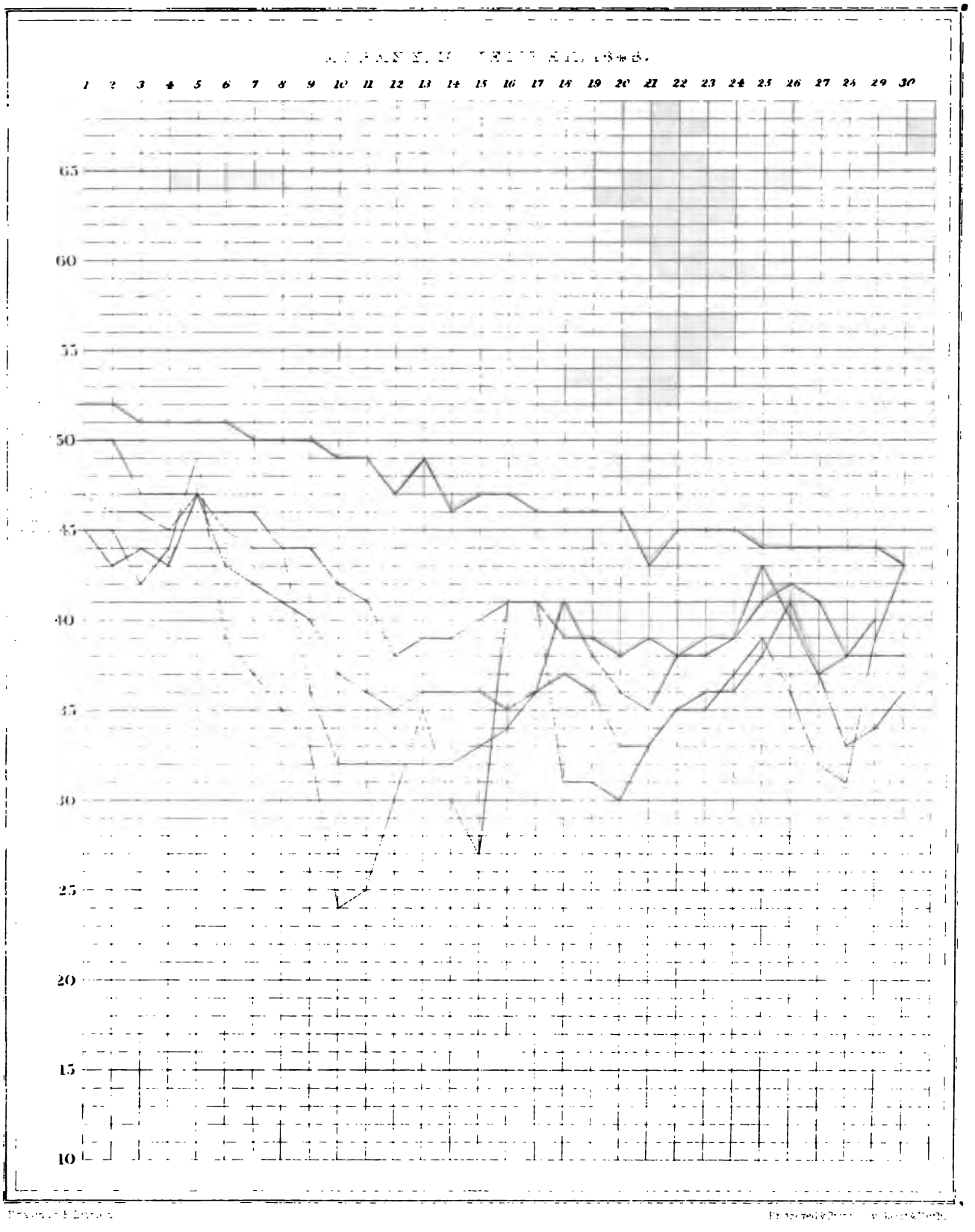

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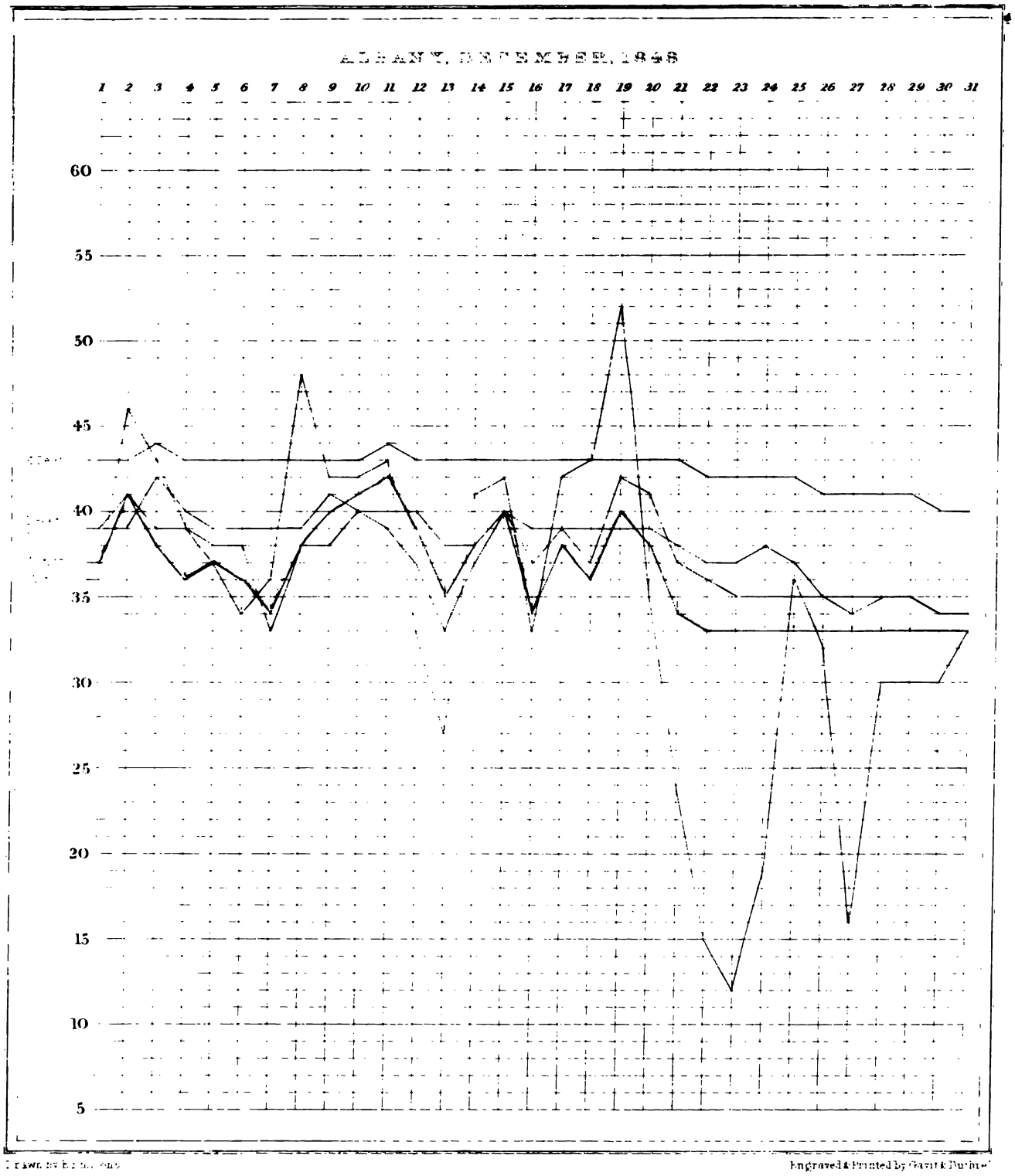
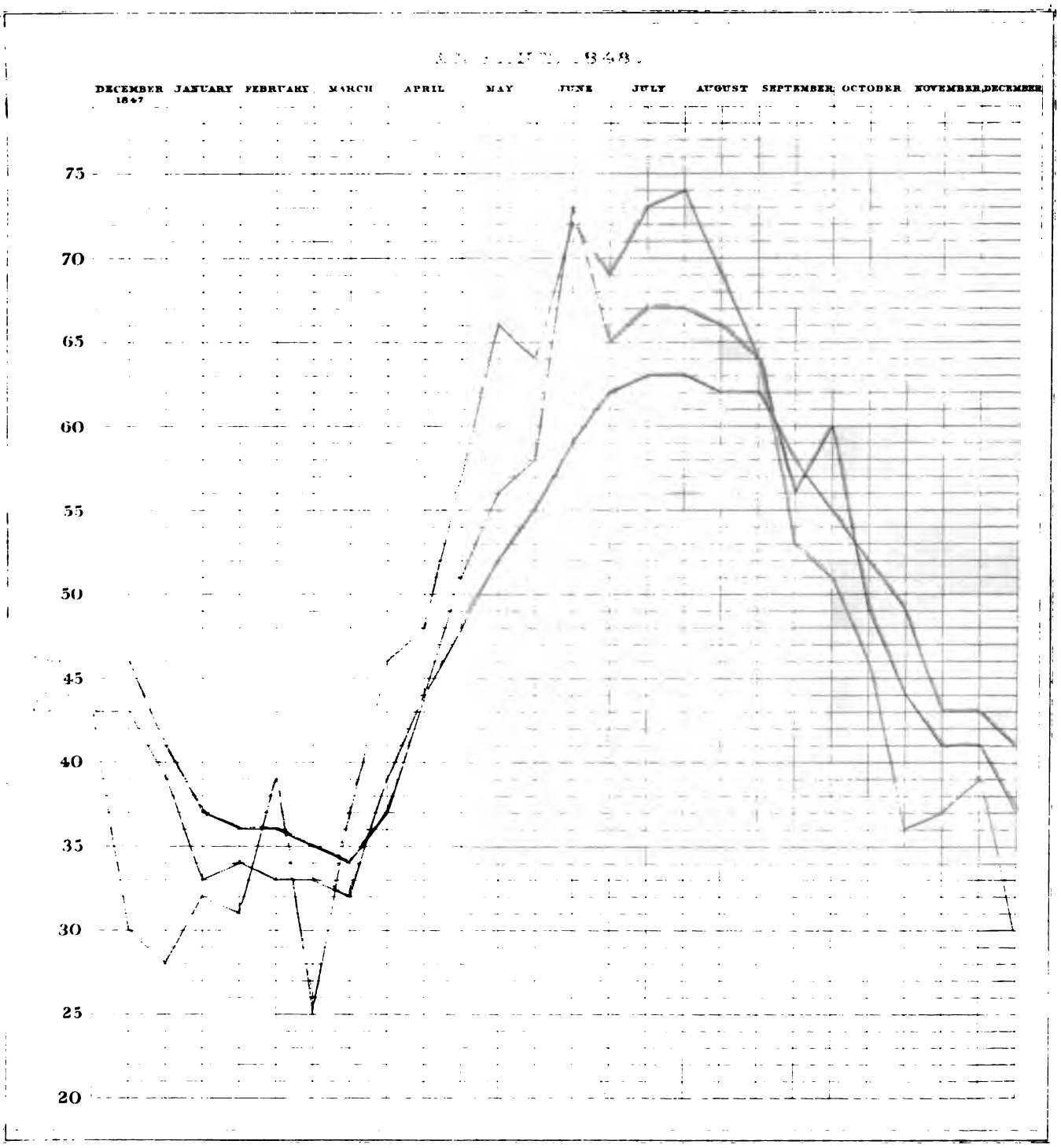


Drawn on Stone by [illegible]

Engraved & Printed by Garrit & Durie

SEMI-MONTHLY OBSERVATIONS
ON THE MEAN TEMPERATURE OF THE SOIL.



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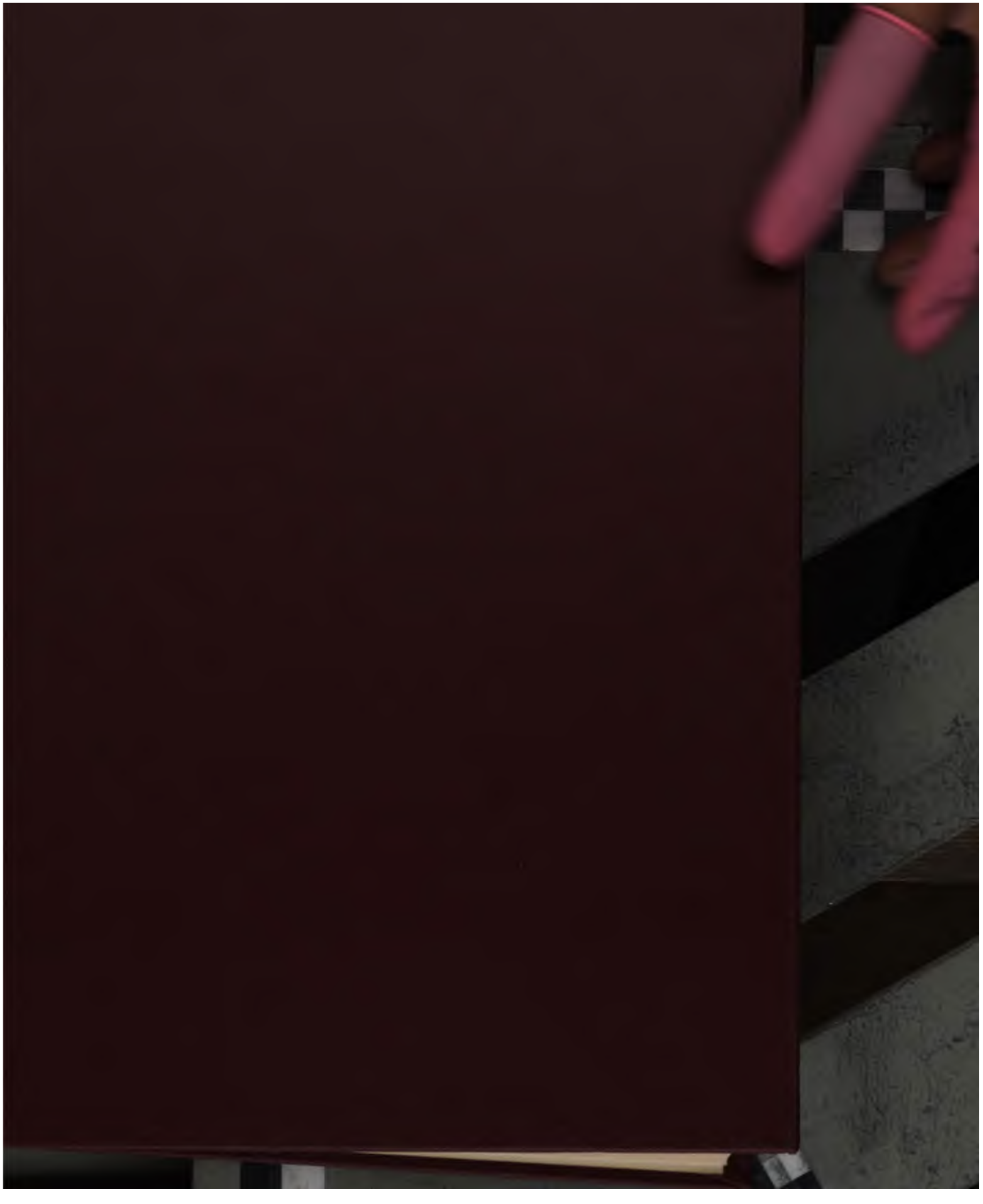
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